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FAMILY  
PHYSICIAN

AND HYGIENIC GUIDE



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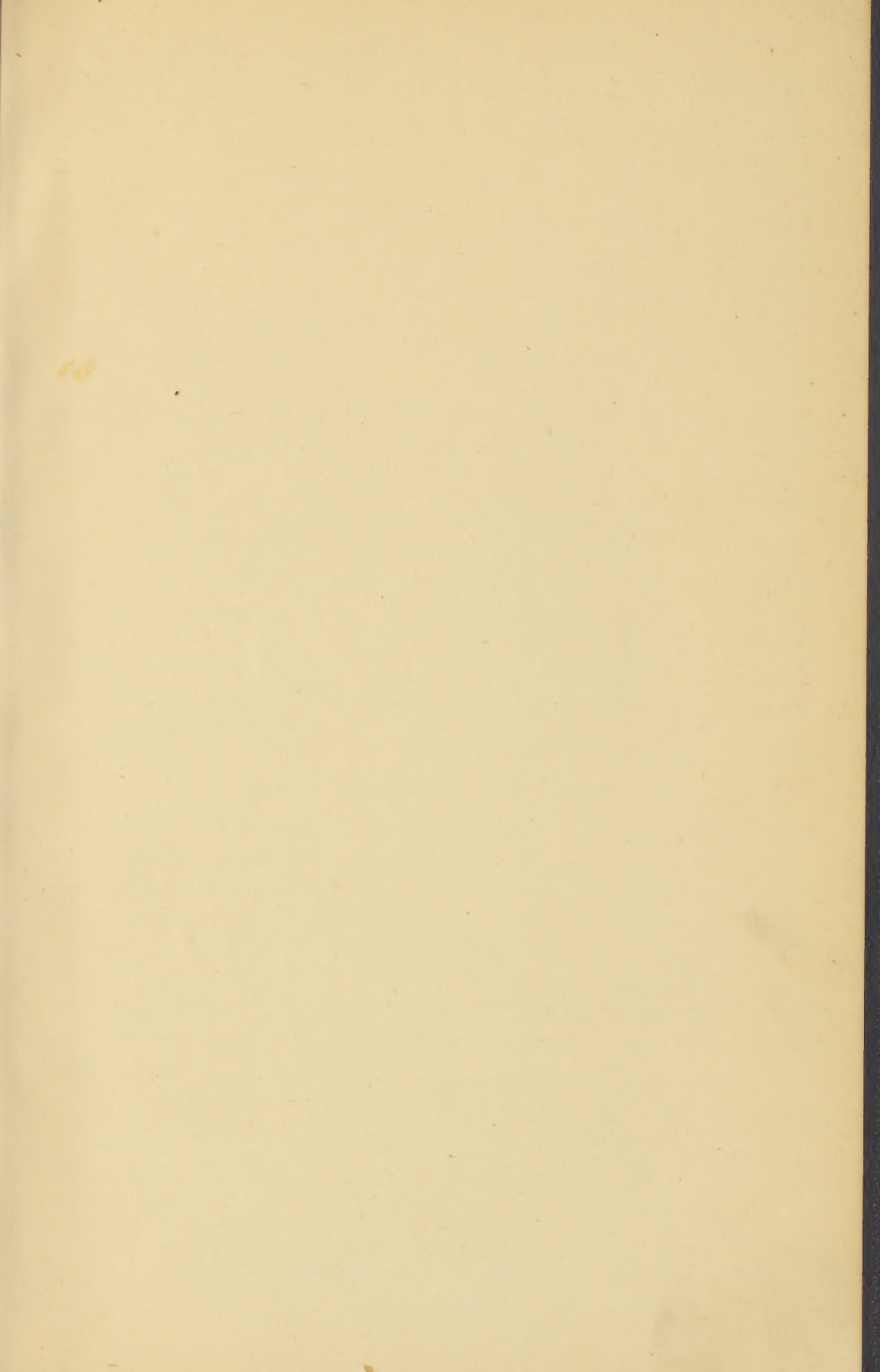
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*The Muscular System, Front View.*

# THE MODERN FAMILY PHYSICIAN AND HYGIENIC GUIDE.

IN FOUR PARTS.

**Part I.**

ON DISEASES: THEIR CAUSES, SYMPTOMS,  
PREVENTION, AND THE BEST AND  
SIMPLEST METHODS OF CURE

**Part II.**

ON HEALTHY DWELLING-HOUSES AND  
HOW TO BUILD, VENTILATE,  
AND DRAIN THEM.

**Part III.**

ON PHYSICAL CULTURE, AND THE HIGH-  
EST DEVELOPMENT OF HEALTH  
AND STRENGTH.

**Part IV.**

ON NURSING AND COOKERY FOR THE SICK,  
WITH MANY OTHER IMPORTANT  
HYGIENIC SUBJECTS.

CAREFULLY PREPARED BY EMINENT SPECIALISTS,

FOR FAMILY AND INDIVIDUAL USE.

BY

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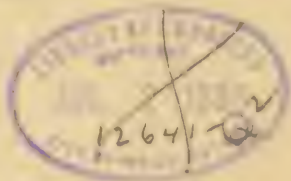
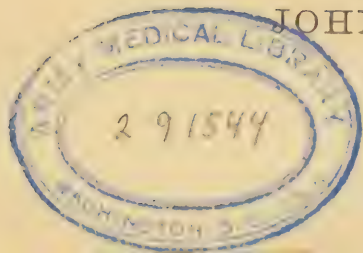
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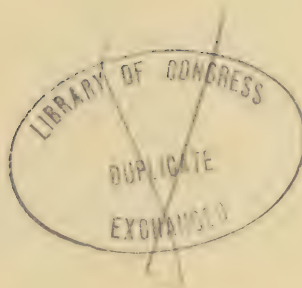


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# PREFACE.

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THE present volume has been written in the conscientious conviction that perfect health is more valuable than any and every other earthly blessing. Its object is to teach its readers how best to prevent disease by strict attention to the rules of Hygiene, and when—usually as the penalty for disobedience to sanitary laws—health is lost, to guide them toward its restoration by the judicious use of the various means devised by medical and surgical science.

It has been urged, with some semblance of truth, that it is a mistake for people to take so much thought about their health, lest, by their anxiety, may be brought on the very illness, perhaps, which they seek to escape. But the folly of this course of reasoning is precisely that of the silly ostrich—if we suppose that travellers' tales in this instance are true—who hides her head in the sand, because it has been proved by experience beyond all chance of controversy, that the blackest intensity of willful or ignorant blindness, will not deliver human beings from the attacks of contagious maladies, such as smallpox, or from the punishment of imprudence in subjecting themselves to the action of poisons, such as strychnia. How foolish would we pronounce the captain of a vessel which had sprung a leak, if he should shut his eyes to the necessity of manning the pumps, hoping that if he did not yield to anxiety, somehow or other the water would cease pouring in through the opening; or what contempt would we feel for the capacity of a householder whose roof was kindling from a spark, if he ignored the necessity of dashing on water, in the blind hope that the fire would go out of itself? The truth is, the problems in regard to the hygienic care of our bodies, are *forced* upon us. We cannot escape them by closing our eyes or averting our heads, and the question is not, whether we will overlook them, or consider them, but whether we will meet them in unarmed ignorance, or choose the wiser part, and learn in time to recognize and avoid the more potent disease-producing agencies.

The section on Diseases and their Remedies, as urgently set forth in the Introductory chapter, is carefully prepared as a substitute for a physician, until a skillful one can be summoned; and as an aid to him afterwards, by supplying detailed instructions for nursing, dietetics and all other hygienic management of his patient.

Whilst earnestly seeking to inculcate a knowledge of the advantages derivable from a dependence upon the specially trained skill of an experienced physician, it is believed that the obstacles which so frequently prevent persons from procuring a doctor promptly in country places, and even in populous cities during certain hours, the proverbial difficulty of finding what you want (even if it be medical



attendance), just when it is most desired, and the exigencies of travel, especially on sea voyages, render such an adviser as this book invaluable to every one. No doubt, the large majority of our readers can recall instances where the want of exact timeliness or promptitude in employing the appropriate means for relief, as, for example, in an apoplectic fit, an attack of bleeding, or a threatened onset of cholera or dysentery, has resulted in death or life-long injury.

Great pains have been taken in the directions for treatment, to guard the administration of powerful medicines, by due cautions in regard to the proper conditions of their use, and to emphasize the fact that sharp-edged tools of the healing art—such as morphia, arsenic and aconite—should only in desperate emergencies be handled by inexperienced fingers. At the same time, where, as already pointed out, urgent emergencies of suffering or danger call for the use of these energetic agents, no childish timidity or infantile prejudice should be allowed to interfere for a moment with their active employment. Resorted to in this way, we trust that the advice given in the second section of Part I. will accomplish a vast amount of good in restoring health to afflicted persons who consult it, whilst that contained in the hygienic portion will perform a far greater service throughout the community by preventing disease.

In Part II., on Healthy Dwelling-Houses, the faults so common in the construction and arrangement of houses, and the very serious effects of these faults upon the health of the occupants, are fully explained. The details of proper house-building are clearly set forth, comprising the selection of a site, the laying of foundation walls, the construction, interior decoration, and furnishing of the house proper, with the best methods of ventilating, heating, and lighting the same, and of supplying water and removing refuse matters.

Part III., on Physical Culture, is devoted to a careful exposition of this lamentably neglected means for securing symmetrical development and robust health; the vital necessity of such education for the young and growing being particularly dwelt upon. A full account of Gymnastics by the aid of mechanical appliances, according to the best system now in vogue, is given, followed by descriptions of the light gymnastics or calisthenics, and of the Swedish Movement Cure, which has been received with such a high degree of popular favor. Lastly, the more important Sports and Pastimes have been accorded a due share of attention, as invaluable contributors to healthful recreation and enjoyment.

In Part IV. are grouped a number of instructive articles on medical and sanitary subjects, including careful essays upon hygienic and household Cooking and Nursing; the care of children and of the aged; the care of the Eyes, Ears, Hair, Skin, Teeth, Feet, and Hands; recipes for cleansing, and general household hints; a full reference table of doses of medicines used in ordinary practice, and other interesting miscellanies relating to medical and hygienic subjects.

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# DISEASES AND THEIR REMEDIES.

A PRACTICAL TREATISE ON

The Causes and Prevention of Disease, with the Best  
and Simplest Methods of Cure,

INCLUDING

DOMESTIC HYGIENE, SANITARY SCIENCE, AND THE GENERAL PRESERVA-  
TION OF THE HEALTH.

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THE WHOLE CAREFULLY PREPARED

FOR FAMILY AND INDIVIDUAL USE.

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BY

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## INTRODUCTION.

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### **The Mystery of Life, Disease, and Death.**

IN the year 1876, the Centennial anniversary of our nation's birth, millions of men, women, and children, coming from every quarter of the globe, travelled hundreds or even thousands of miles to see the Great Exhibition in Philadelphia which celebrated a century of Liberty and Independence in our favored land.

Among all the marvels of art, of science, and of mechanical skill grouped in these grand treasure-houses of products from every country, no one attracted more attention from foreigners and citizens alike than the magnificent Corliss engine which, set in motion by President Grant and the Emperor of Brazil on the opening day of the fair, moved most of the machines in Machinery Hall until the end of the Exhibition. This superb show has long since passed away; but in order to see a far more wonderful machine than even the great Corliss engine of the Centennial, each of my readers need only examine his own body, which, in its marvellous contrivances and the astonishingly exact fitness of all its parts for the duties they are required to fulfil, infinitely surpasses any mechanical apparatus hitherto constructed by man. Thus, for example, no telegraphic machine ever exceeded in delicacy and complexity the human brain and nervous system; no pump ever did its work more successfully than our hearts do theirs in driving the blood through every artery and vein into all portions of the human frame; no chemical apparatus ever performed its part in digesting solid substances better than the human stomach and associated organs fulfil their office as long as the whole body is in perfect health. But every one can behold at home, in his own body, a *more* wonderful machine than any which those vast crowds journeyed so far to see in the Centennial Exhibition, and this infinite superiority of the All-wise Creator's work over any mere man-made contrivance lies in the inborn power of the former to repair itself when injured, this repair being generally more or less complete according as due care is exercised in obedience to the rules of hygienic, medical, and surgical science to favor the reparative

tendency in every appropriate way. If, for instance, the great walking-beams of the Corliss engine had been broken, the whole machine might have stood still until doomsday, as far as any effort to mend itself was concerned; but if a human being were to break his walking-beams, that is to say, the bones of his legs, and were wise enough to lie still with the broken limbs in a proper position, maintained by suitable surgical appliances, the ends of the fractured bones would, after a few weeks or months, "knit" themselves together, and he might in time be able to run and jump as well as before the accident.

### **Inestimable Value of a Knowledge of Hygiene.**

As most persons are doubtless aware, the study of this most wonderful of all machines, the human body, is called Anatomy, a term, derived from two Greek words, signifying *dissection*, because it is only by separating such a body into its component parts that we can tell how it was put together. Physiology describes the active operations of these various parts and organs during health, as, for instance, how the heart propels the blood through the arteries producing the pulse, how the stomach digests food, and also how the operations of the special senses, such as sight and hearing, are performed. Hygiene, the art of preserving health, derives its name from *Hygiea*, the appellation which the old Greeks gave to their fabled Goddess of Health. It is the practical application of the sciences of Anatomy and Physiology to the hourly and daily needs of every man, woman, and child in the world, and it is far more useful to humanity than practice of Medicine and Surgery, because, even with our present knowledge of Sanitary science, we can avoid many more attacks of disease than we can cure. It, therefore, constitutes the chief subject of this book, the purpose of which is to teach its readers how to keep their own valuable bodies—worth, as long as they are not sick, tenfold more than their own weight in the purest gold would be—sound, healthy, and free from taint of disease.

Some physicians of profound learning declare that all the time, trouble, and money employed in acquiring their knowledge of medical science would have been well expended in gaining their control over diseases, even if that mastery should never be exercised outside of their own households. And further, that the longer they live and the more they practice medicine, the more sure they become that the cure of existing disease, and when that is impossible, the relief and mitigation of its pain, is the greatest service they can render to humanity, or that humanity in time of need can render unto them.

If then, medical practitioners find the ability of curing disease in themselves and their own families, is alone sufficient reward for all the toil of their lives in study, how much more worth while is it for the



readers of this volume to devote their best efforts to learning from its pages how to prevent diseases, or to nip them in their very bud by appropriate hygienic measures. Obviously, preventive medicine has all the advantages over curative medicine that the traditional ounce of prevention has over the black, bitter, and oft ineffectual pound of cure. Hence it is that the far-sighted prophets of the medical profession agree with singular unanimity, that the medical science of the future will be "Preventive medicine."

All those who have learned the value of health by its loss, will approve most heartily the advice here given to everybody, and especially to young people, that they should continually remember health is the one worthy object in this life to the attainment of which they can most profitably devote their time, strength and energy, and all the intellect, all the arts, all the sciences, and all the industries of mankind are chiefly valuable to each individual, as they contribute to the acquisition and maintenance of typical health for his individual body and mind. Or to coin an aphorism which should be posted over the doorway of every dwelling in the land: perfect health is the *pure gold*, whilst without it, power and glory and riches are but the *mere dross* of human existence.

### Definition of Hygiene.

The late illustrious Dr. Parkes, who probably did more towards awaking public interest in the care of health in all English-speaking countries than any other philanthropist of our time, has left a worthy monument of devotion to his fellow men, in his comprehensive treatise upon the subject, which contains the following unequalled definition. "Hygiene is the art of preserving health, that is of obtaining the most perfect action of body and mind during as long a period as is consistent with the laws of life. In other words it aims at rendering growth more perfect, decay less rapid, life more vigorous, death more remote."

In the widest sense of its meaning the word Hygiene signifies rules for perfect culture of both mind and body, because it is never worth while to attempt the cultivation of either of these integral parts of the being separately, since each acts and reacts upon the other, in ways which are mysterious and intricate to the utmost degree. For a perfect system of Hygiene, therefore, must be combined the knowledge of the clergyman, the physician, and the schoolmaster, in order to train the material body, the intellectual powers, and the moral soul in the most complete and most accurately balanced order. Then exclaims Professor Parkes, "If our knowledge were exact and our means of application adequate, we should see the human being in his perfect beauty, as Providence, perhaps, intended him to be; in the harmonious proportions and complete balance of all his parts, wherewith he came forth from the hands of his Maker, in whose divine image we are told he was, in the beginning, made."

Dr. J. S. Billings, late president of our National Board of Health, considers that the field of Sanitary Science is still more extensive, and declares that the study of hygiene includes the examination of the conditions which affect the generation, development, growth, and decay of individuals, of nations, and of races, being on its scientific side co-extensive with Biology, or the science of life in its broadest sense, including, therefore, Sociology. Whatever can cause or help to cause discomfort, pain, sickness, death, vice, or crime, and whatever has a tendency to avert, destroy, or diminish such causes, are matters of interest to the Sanitarian, and the powers of science, and the arts, great as they are, afford, even when taxed to their uttermost, only an approach to the solution of the problems with which he is concerned.

But if we go no farther than Dr. Parkes' definition that Hygiene is the art of preserving health, it appears obvious that, since self-preservation is the first law of nature, and from first to last is the most universally inexorable in its demands, a thorough investigation of the best methods of securing self-preservation of every organ and function in entire integrity, such as is attempted in this book, might be rendered the most important, the most useful, and the most interesting, which could possibly engage the attention of every man, woman, and child in the world. It is said "might be," because as is commonly observed, few people value health properly until they lose it, and therefore it can scarcely be hoped that all readers will appreciate now fully the inestimable value of sanitary precautions in self-preservation. But the day will come to all, except the few whose lot it is to fall by sudden death, or disease accompanied with failure of intellect, when they will realize, let it be hoped before too late, how momentously true are these words of urgent remonstrance that it will pay better to preserve every part of our valuable bodies and minds in complete perfection, by obedience to the laws of hygiene, than it will to pursue in violation of them any other occupation or amusement ever invented by man.

From this point of view practice of medicine and surgery, which have for their objects the remedying of evils resulting from neglect of hygienic laws for our self-preservation, hold a secondary and subordinate place in the interests of mankind, being of less real and vital importance to each and every one of us and to humanity at large.

Admitting, as most people will, without dispute that according to the old adage, "the proper study of mankind is man," little farther argument is needed to prove that the maintenance of health is the object towards which he can make the best and wisest application of such study, because, as is declared by the ancient Roman poet, the one earthly blessing we dare ask for unreservedly, a sound mind in a sound body, is the great element of all earthly happiness, without which the richest prince, the most powerful king, or even the wisest sage, is more miserable than its very meanest possessor.

### How to Preserve Health.—A Most Valuable Knowledge.

The pre-eminent value of the study of man and nature, as a means for obtaining that condition of every enjoyment, health of body and mind, being acknowledged, it is easy to see farther that the surest mode of securing health is by acquiring the most extensive possible knowledge of its derangements, as effected by the countless external agencies and forces of nature, and thus learning what noxious influences we must avoid, because, as every one knows, ignorance of nature's laws no more absolves us from the penalty of their violation, than will a similar want of knowledge be accepted by our courts of law for an infraction of their code. For example the innocent child, who eats a spoonful of the deadly poison, arsenic, believing that it is sugar, and in ignorance of that divine ordinance which has decreed it to be fatal to us, is as surely and, without assistance, as fatally poisoned, as if he had committed the most monstrous sin; whilst on the other hand a man who has swallowed the same drug, though he be the greatest criminal in the world, if he is well enough informed concerning the laws of nature to promptly take an emetic, will be saved, as a direct consequence of that superiority of wisdom. Since then ignorance of causes which produce the changes of disease is continually punished, with the blackest of all crimes, by death; and, on the contrary, knowledge of these same causes is rewarded with the highest earthly prizes for resplendent virtue, Life and Health, it is manifest that our chief interest, and our duty, in order to secure these blessings of life and health for those under our care, many of whom are as ignorant of common injurious agents as a baby can be of arsenic, is a comprehensive study of disease with all its innumerable causes, symptoms, remedies, and effects.

The science of Hygiene, like all other great things, is exceedingly simple. This hypothetical case of an innocent child eating Arsenic through ignorance of its deleterious properties is a perfect illustration of the sanitary errors we and all our friends and relatives are constantly committing almost every moment of our lives. The great duty in writing this volume is to teach its readers and help them to teach others whom they can influence, how to know and avoid or escape "Arsenic," to continue the figure of speech, in all its various forms around them. And whilst the good thus accomplished must fall far short of that which is intended, it is hoped that many readers will hereafter have occasion to offer sincere thanks in their hearts, that they and those dear to them have been saved from unnecessary suffering, by the earnest cautions and warnings against eating and drinking, chewing and smoking, breathing and wearing, working and thinking "Arsenic" and its kindred poisons, in their infinitely diverse aspects, which will be urged upon their remembrance.



That these dangers to health from the multitude of natural forces and influences which everywhere assail us are not mere visionary ones is shown by the fact that, from reliable statistics, it is estimated the total annual loss of life in the United States, from causes well known to be preventable, is certainly equal to over one hundred thousand persons; whilst if we consider what is theoretically possible if the laws of hygiene were generally and strictly observed, this enormous death roll would double or even treble its magnitude.

In addition to these unnecessary deaths there are probably one hundred and fifty thousand persons sick in the United States from causes which there is good reason to think are preventable, and it is reasonably certain that the average amount of work accomplished in this country is only about seven-tenths of what it would be if all attacks of preventable diseases were avoided by due sanitary care of our bodies.

If we look back into the history of past ages when hygiene was comparatively almost unknown, we can perhaps most readily trace the benefits of sanitary science. The Romans constructed some magnificent aqueducts for supplying the seven-hilled city with pure water, and they also built certain capacious sewers for removing their refuse matters, but what we understand by public sanitary effort they were utterly unacquainted with. Even England with all her greatness and wealth of intellectual production was a very hot-bed of disease, and to English history we may turn for examples of the most frightful pestilences. What could be more terrible than the "black Assizes," a session of an English law court held in Oxford in 1577, where all who were present in the court-room—the judge, the sheriff, and some three hundred other persons—died within forty-eight hours? What could be more appalling than the Black-death of the fourteenth century, which reappeared in an epidemic form as the plague five times in the next century, and in the year 1665 carried off the enormous number of seventy thousand persons. So terrible was this disease that one writer says,—“the plagues of London do commonly kill one-fifth of its inhabitants.” In fact, inhabitants of the Northern States can scarcely form an idea, at the present day, of such an epidemic as visited London in the year 1665. The narrative of Defoe, depicting its scenes of daily occurrence, is full of pathetic incidents. He tells us that all the infected houses were closed with their inhabitants imprisoned within them. They were marked on the outside with a red cross, and written over the door was “Lord, have mercy upon us.” When however we consider how the English people of those days lived, we are surprised, not that epidemics of this terrible kind occurred frequently but that they were ever absent. Most of the dwellings were of wood and so tightly plastered over that a breath of fresh air was an entire stranger. Our English ancestors had to pay a window tax, so that from economical motives even the light was to a great extent excluded. The floors of the houses were generally made

of loamy earth, covered over with rushes. From time to time fresh rushes were strewn upon the old ones, and the decaying mass was left sometimes, it is said, for twenty years without removal, concealing fish-bones, broken victuals, and other filth. And this was what is called the good old time.

### **The Progress of Practical Hygiene.**

Some of the clearest numerical evidences proving the benefits of hygiene are derived from the record of births and deaths, accurately kept in Geneva, Switzerland, for the last three hundred years. From these we learn that, three centuries ago, the average length of a human life was only twenty-one years, whilst now, in the nineteenth century, it has risen to forty years; then, more than one-fourth of all the children born died in their first year; now, less than one-sixth perish in their first twelvemonth. In the sixteenth century, only three per cent. of the inhabitants of Geneva lived to round out their three score and ten years; now, more than eighteen per cent. outlive the period for human life allotted by the Royal Psalmist of Israel. As many now live to be seventy as then survived the age of forty-three. Again, statistics prove that in the crowded city of Liverpool before proper sanitary measures were adopted, thirty-nine persons in every thousand died each year; whilst at the present time the number of deaths per thousand is only twenty-four. The mortality in England's East Indian army has been reduced from sixty-nine to twenty per thousand annually, and so great a difference has this made that, in a single period of ten years, more lives have been saved in that army than formed the whole British forces at the battle of Waterloo. The lessons taught in our late terrible civil war in America are in this respect equally impressive, for it was found that, through the often inevitable neglect of proper sanitary care, feeding, and clothing of the troops, for almost every man killed in battle two men died of disease, nearly all of which might have been prevented had every resource of science for the preservation of health been duly applied.

### **Disease is Disturbed Life.**

The readers of the preceding section being, it is trusted, fully convinced of, first the inestimable importance, and second, the great practical feasibility of preserving health for ourselves and our children by attention to the laws of hygiene, we will now commence at the very foundation of the science by attempting to explain, or at least to define, that wonderful Vitality which necessarily forms the theatre, as it were, of all the operations with which we have to deal in pursuing the study of Sanitary Science.

Life, the life to which we, in common with all other created beings, cling so despairingly, and which is only less mysterious than its inevitable and

inexorable termination, the mystery of death, has been defined by a celebrated French physiologist as "organization in action." Taking the word organization in its usual sense as meaning a body made up of organs, as the heart and lungs for example, this brief phrase admirably expresses the ordinary condition of living bodies, as offered to us everywhere in water, air, and earth for our inspection and study. In the lowest forms belonging to the animal kingdom, the active operations which characterize Life are capable of actual demonstration under the microscope. In the curious creatures called *Amoeba*, for example, which look like microscopic drops of transparent jelly, we have presented to our view all the important functions of vitality in its simplest manifestation. In these strange little animals we may really see correspondingly minute vegetables gradually enclosed, partly digested, their nutritious ingredients appropriated, and the remainder cast away in a comparatively short time. Of course the functions of development, growth, reproduction, locomotion, and so forth, which are in the animal kingdom the attributes of life in some of its stages, must generally enter into our consideration of the subject, although they are not essential to the idea of vitality.

Now life may be natural or *normal*; that, is nutrition, excretion, and so forth, may be so proportioned to each other that the individual possesses the greatest perfection of each and all of its powers, and thus enjoys what is commonly called health. Or, again, the various functions above referred to may bear a disturbed or *abnormal* relation to each other, constituting the condition we denominate disease, the general, although not quite universal, index of which in our race is *pain*. Here we have the physician's life-work set before us in a single sentence, and it is as well the great business of his beneficent calling from the days of Hippocrates, the father of medicine, down to the end of Time, namely, to obviate in suffering humanity these disturbances of bodily action which constitute disease, and to relieve, or at least palliate, their eloquent appeal for succor—*pain*. No earthly service can win a richer reward from the people of all generations and of all nations. No human gratitude can compare with that poured forth by patients who have just been delivered from the agony of physical pain.

Since disease consists in the disturbance—that is, the alteration for the worse of nutrition, excretion, and so forth—in two words is disturbed life, it is obvious that the causes of disease are any agencies whatever which produce this derangement. Of course, then, they necessarily include all the innumerable powers and forces which surround us. Thus, the excess or the privation of the air we breathe, the light and heat which promote the conversion of food into our muscle, blood, and brain, the electrical forces which modify our nutrition—any of the myriad diverse influences which may be brought to bear upon our frames—are at times more or less potent causes of disease.



Life, then, is "organization in action." Health is "perfect organization in perfect action." Disease is the "disturbance of perfect organization, or of perfect action, or of both together;" and disturbance or perversion may occur, of course, with both organization and action in either of the two opposite directions of excess or deficiency. Thus, for example, we sometimes see a perversion of the organization of the skin of the leg in the direction of overgrowth, constituting the curious disease called Elephantiasis, because it makes the sufferer's limb look like that of an elephant; or, on the contrary, we may meet with a wasting away of the muscles of the arm, producing one kind of paralysis or palsy. The functional diseases, as distinguished from organic diseases, are those in which the function or action of an organ is disturbed, without any visible alteration of its substance or texture having taken place. Illustrations of these conditions are readily found in cases, for instance, of excessively violent, rapid, and irregular beating of the heart, commonly spoken of as palpitation of the heart; or, on the other hand, when the function of the heart is performed so feebly that it seems to almost cease, as is frequently observed in an ordinary fainting fit.

Perhaps this important idea, that disease is a disturbance of natural life, can be most forcibly impressed upon the reader's mind by a mechanical comparison. Thus, for example, our bodies, with all their ingenious contrivances and wonderful adaptations of parts to the various objects they are designed to fulfil, may be compared to an intricate machine such as a steam-engine, which, when in complete running order, with every valve, wheel, and lever acting in just mutual relationship, represents, except that it is far less complex, a healthy human frame. But let a screw work loose so as to allow a little leakage at the steam-pipe, or the oil dry up so as to prevent the free play of a valve, or an eccentric wheel slip a little on the shaft so as to shorten the stroke of its rod, and we shall have resulting an imperfect action, manifested, perhaps, by an audible escape of steam, a slower rate of movement, or a loss of operative power: in fact, the precise equivalent of that *derangement* of our systems which from time immemorial has received the name of *disease*. If, now, we suppose a skillful workman called in to rectify the disordered engine, we will see him examine the movements while running faster or slower, try with his wrench one and another screw-head, and listen here and there for the rush of steam, all these tests being systematically applied to detect the exact seat and character of the little mechanical defect which interferes with the perfect action or function of the engine, and on which, consequently, the whole disorder depends. Now just as the machinist employs his trained senses to discover the disease of his engine from its symptoms, that is to say, its interferences caused by that valve-disease, or that piston-rod disease, with the best action of the machine, so a thoroughly scientific physician, when consulted as a practitioner of

either Preventive or of Curative Medicine, will devote his keenest and best-trained perceptions, aided if needful by the microscope, the stethoscope, the thermometer, and other mechanical appliances, towards determining the threatened or existing changes of structure in a patient's body by the symptoms, that is to say, the departures from the perfect action of typical health, which their interference, even in their earliest stage of development, often produces in the functions of his body.

This view, that all diseases are simply departures from and disturbances of perfect health, may seem strange to some of my readers, because, not a great many years since, both medical men and the community at large looked upon each distinct malady as a separate existence or *entity* which, in some mysterious way, fastened upon our vitals, and, if not cast out by drugs more potent than itself, destroyed its victims in the deadly struggle which ensued between it and the life-force of the individual assailed. At present, however, the more enlightened physicians recognize no such antagonists, but consider the disorders to which all flesh is heir as disturbances of perfect life, which as a rule are gradual in their commencement, and even more gradual in their decline. Hence, such terms as to struggle against a disease, or to do battle with a malady, should only be used in a figurative sense, and with reference to the causes of complaints or to the symptoms and effects of an illness, as, for example, the debility and the diarrhoea which occur in typhoid fever.

In the illustration of a disordered steam-engine, used above, the importance of calling in a skilled artisan to examine and repair the apparatus, has been referred to; and the same precaution is a thousand times more necessary when that infinitely complex and delicate machine, the human body, is disturbed in disease. In such a case only the best trained and most experienced workman that can possibly be obtained should be permitted to meddle in any way with the derangements of this marvellous structure.

#### **The Doctor Needed in Serious Cases.**

It is an old saying, that "Any man who tries to be his own lawyer has a fool for his client;" and whilst there may be an occasional exception to this rule, it is as generally correct in regard to amateur lawyers as a similar condemnation of amateur physicians would be just. So universally is this fact recognized, that physicians, when ill, do not commonly attempt to prescribe for themselves, but entrust the management of their cases to some medical friend, whose advice they are confident will be unaffected by the pain, the fever, the fear of death, and other physical derangements, which, save in rare instances, more or less warp the judgment and disturb, however unconsciously, the reasoning powers.

Nowhere in the whole circle of the sciences is a little knowledge a more dangerous thing than in medicine; and conscientious physicians, who have withdrawn from active practice, and consequently fail to keep

their minds fully informed respecting all the improvements of medical science, and their faculties well trained in the use of the instruments and the active remedies which constitute the sharp edge-tools (not to be handled by children unless life is at stake) of their profession, will often be found declining to take the responsibility of prescribing for any serious illness.

If each inhabitant of America could have an experienced doctor constantly at his elbow to advise him in all the medical and sanitary emergencies of life, these pages would never be needed. As, however, such a desirable precaution is an impracticable one, this work is offered as a substitute for the medical guide, who should be sent for as quickly as possible whenever any emergency arises or any departure from perfect health makes itself manifest. Each and every reader is most earnestly warned against trusting to their own application of the directions herein set forth for treating or even nursing a sick patient, if a competent physician can be obtained, because only the most thorough education and careful training can justify a man in taking upon himself the awful responsibility of a fellow being's life during a serious illness, unless forced to do so. Moreover, even the most skillful medical scientist cannot always tell how severe an attack, which is mild at first, will ultimately prove, and how much more probable is it, then, that a person, however intelligent and well read, who lacks practical experience in disease will fail to observe the earlier symptoms of dangerous maladies, and so allow to slip by unheeded and unimproved that golden moment in the forming or incipient stage of nearly all departures from health, when medical treatment is most efficacious, and after which, in too many instances also, all the resources of the art and science of medicine utterly fail.

Most emphatically, then, is it urged upon every one who consults these pages, *not* to depend upon the recommendations they contain, except during the minutes or the hours which must often elapse before a skillful physician can be summoned. Furthermore, in no instance of serious illness, or of that which, though it is apparently trivial in its nature, seems at all doubtful, should the calling in of the best medical advice which can be secured be delayed for an unnecessary moment.

On the other hand, when, as must frequently happen, in small towns, villages, in thinly settled rural districts, at sea, or whilst travelling in foreign lands, a doctor cannot be procured immediately, prompt treatment by any intelligent person as directed in this work might save an immense number of lives and a vast amount of human suffering.

### The Efficacy of Preventive and Curative Medicine.

Although it is customary to hear wits and wise-acres ridicule both the science of medicine and practitioners of the healing art, it is generally found that those who jeer most bitterly and sneer most unsparingly, are



the most eager to seek for medical aid the moment they begin to suffer pain or are assailed by the dread of death approaching themselves or some beloved relative or friend. Experience teaches that, whilst there are, unhappily, many diseases for which no certain cure has yet been discovered, physicians are rarely called to a case, probably not more than once in a hundred instances, in which we cannot either prolong the patient's life, or alleviate the agonies of suffering which, without medical assistance, he would be forced to endure.

There is a class of medical practitioners who, either for the purpose of exciting astonishment at their singularity, or admiration at their affected frankness and honesty, decry the power of medicine and of medicines in a way which has worked a vast amount of evil in the world. This kind of medical skepticism is as great and as pernicious an error as the medical superstition which could confide in the curative powers of Perkins' tractors, the weapon ointment, the royal touch for scrofula, and other follies of past ages. Such skepticism inculcates doubts as to the activity of nearly all drug medication, and lauds beyond everything else the *vis medicatrix natura*, or curative power of nature, claiming that to it recovery from illness is chiefly due.

A similar skeptical spirit leads men, who put on oftentimes a great assumption of superior wisdom, to ridicule the scrupulous care which most contributes to health and long life, quoting, perhaps, the old Latin proverb which declares that he who lives medically lives miserably, as an excuse for their neglect of proper precautions against disease.

Even such persons, however, with all their lofty contempt for prudence, may occasionally be seen hastily withdrawing from a railway track when a locomotive approaches, or cautiously avoiding a small-pox patient if they happen to recognize one in the street, and very few, after their boasted courage has, by involving them in serious loss or injury to health, justified the name it will commonly receive of foolhardiness, fail to lament that they had not been wise in time, learned how to avoid the danger of accident or disease, and practiced that knowledge with the watchful care so urgently recommended in this book.

A most important and useful lesson in regard to the wisdom of sanitary precautions and surgical or medical treatment, may be drawn from the common accident of having a cinder enter the eye (as it is called) on a railway journey. Trivial as this misfortune seems at first, the painful irritation which the tiny particle of coal, if not removed, soon sets up under the lid is far more troublesome than the hygienic precaution of wearing wire-gauze spectacles for a lifetime of railroad travelling would be. And the simple operation of removing the cinder as advised in the chapter of this work on diseases and injuries to the organs of vision, saves the person days or weeks of intense suffering, and effects what the blundering *vis medicatrix natura* would have set up such a violent inflam-

mation to accomplish, that its patient's eye would very likely have been ruined for life in the operation of washing away the tiny cause of disturbance.

And in regard to medical treatment the same truth is manifest. Every physician in large practice can, probably, bring forward scores of cases where a single hypodermic injection of morphia has cured neuralgia; a scruple of quinine has broken up ague; a few doses of cough mixture has cut short an attack of bronchitis; or two or three pills of acetate of lead and opium have checked an attack of cholera morbus; which, if left to the vaunted curative power of nature, would in all human probability have cost the patient his life, by the long-continued suffering and exhaustion they would involve. In fact, the great business of an intelligent medical practitioner is often to correct the murderous blunders which are constantly being made in patients' bodies by the *vis medicatrix naturæ*. To do this we happily possess, in the wide range afforded by nature among her medicinal substances, remedies which, if used early enough and wisely enough, grant us a hope of cure in every disease except old age, which, if it be looked upon as arriving to one particular organ of each individual sooner than to the others, is but a part of Death, the unconquerable adversary of all earthly life.

As an all-wise Creator has intimated to his creatures by giving to most medicinal substances a bitter or nauseous taste, every dose of medicine is an evil only to be accepted by a wise man when it is a lesser evil than the disease which it is administered to cure.

In reference to this question of medication, there is no doubt that many people commit serious errors in each direction of excess and deficiency. On the one hand, there are numerous individuals, and whole groups or sets of persons, who refuse to take into their stomachs certain of our most valuable drugs, because these remedial agents have been in other times, or other ages, abused, to the grievous injury of mankind. Thus, it is by no means unusual for a patient to consult his physician and, as the latter is writing his prescription, to say, "Doctor, please don't give me any calomel, for I had an uncle who always said his constitution was injured by the mercury he took when a child." And yet, such a request is not one atom more reasonable than it would be for the same person to take his watch to be repaired and say to the watchmaker, "I want this time-piece put in first-rate order as quickly as possible, but don't use a screw-driver in fixing it, for I have a prejudice against screw-drivers, because an uncle of mine had his watch ruined by a screw-driver when he was a boy." We can scarcely dispute the assertions that calomel (and mercury in other forms as well) is a very active medicine, potent for ill as well as for good, and that half a century ago it was far too freely and too frequently administered; but when it is given to a suitable case, at the right time and in proper quantity, few remedies are more valuable in their



effects. Again, on the other hand, there is a class of people who, in consequence of having once experienced the blessings of medicine as a reliever of pain, from fashion, or from pure lack of other occupation, go to the opposite extreme of overdosing, and fill their stomachs with immense quantities of regular and irregular prescriptions, to their own serious or even fatal injury.

Common sense dictates a course of action midway between these extremes, not only guarding oneself vigilantly on all the more important points of sanitary precaution when reasonable suspicion of danger exists, but meeting the attacks of disease, which, in spite of every care, will be sure to fasten on humanity sometimes, as promptly and energetically as medical science can enable man to do.

But whilst extensive experience has taught physicians a strong confidence in the efficacy of hygienic measures against disease or accident, and likewise a robust faith in the power of medicine over disease, as well as over most of its causes before they begin their operations upon the human body, they know enough of human nature to feel sure that many readers will not only insist on trying occasionally how far they can venture unscathed in violation of the laws of hygiene, but also that, when they begin to suffer for such disobedience, they will often persistently neglect to avail themselves of "the pound of cure" which stands prescribed, trusting that their disease "will get well of itself." For such headstrong individuals, the best wish is that they will test the value of these counsels first, in regard to some sanitary regulations which have attached to them the penalty of temporary pain, rather than that of death, or of permanent injury. In other words, that if the bold seeker after truth is, for example, predisposed to consumption, as pointed out in the sections on age, hereditary tendency, and the like, he will be careful about his lungs as he finds advised, and buy his stock of wisdom with experiments, let us say, upon his digestive apparatus, when the punishment may happily prove a mere attack of dyspepsia, that cruel enemy of civilized life, which has been so poetically and so truthfully described as the "remorse of a guilty stomach."

### **Modifying Influence of Race on Disease.**

The present chapter comprises the consideration of those modifying influences which, affecting all who are exposed to them, whether sick or well, have a very great power over mental and physical welfare. The most general, if not the most potent, of these is race.

Although Prof. Agassiz claimed that there were eight distinct centres of human creation, corresponding to those of the plants and animals with which they were associated, his views have not yet been able to displace the older classification of Blumenbach, which, following to some extent the Mosaic record, derives all the different nations of the earth



from a single stock, and divides mankind into five races, namely, the Caucasian, Mongolian, American Indian, Malay, and Negro races.

In order not to occupy space with an account of investigations which, however interesting in themselves, have but little practical bearing upon American hygiene, only the three races commonly met with in this country will be here considered.

The first of these, the Caucasian or European race, is and has been, for the last two thousand years at least, confessedly the highest type of manhood, both intellectually and physically. The external characteristics are too well known to require comment, and whether on account of these structural peculiarities, or because they are endowed with a greater supply of life-force, the capacity for resisting the effects of agents prejudicial to health is greater in the Caucasian than in other races. In consequence of a more artificial mode of life, a great variety of unhealthy occupations, and other influences of civilization, the number of diseases to which members of the European race are liable exceeds that of those which assail other races. Nevertheless, the many developing and sustaining agencies acting upon Caucasians, apparently render their mental and physical organizations so much stronger, that the causes of disease make much less impression upon them than upon varieties of the human family which are less highly favored. As a consequence, the average duration of life is, with some exceptions, decidedly longer in the white race than in any other. On this account, too, the power of adapting himself to climate, and living or even flourishing under the scorching sun of the Torrid, or amid the biting cold of the Frigid zone, is greater in the Caucasian than in any other race.

#### **The American Indians.**

The American Indians are so rapidly fading away before advancing civilization, that they afford by this very fact a lamentable proof of their physical inferiority to the Caucasian race. As elements in the process of extinction, we find that diseases of the lungs, especially consumption, and that contagious diseases, such as small-pox, and epidemic maladies like cholera, are particularly fatal. By way of partial compensation, it is observed that, although intoxication is exceedingly common among Indians, they seldom or never suffer from delirium tremens; and Sartorius declares that an Indian's skin is much less sensitive to heat and to cold, also that injuries and wounds heal with much greater rapidity, and are attended with less fever and other disturbance of the general system, than in white men. Idiocy and insanity are less frequently met with among Indians, but they rarely attain to a very advanced old age.

#### **The Negro Race.**

The Negro race in North America is living at a great disadvantage, being exposed to a soil, climate, habits, and civilization totally foreign to

it. In his native country, Africa, the negro exists in the lowest depths of barbarism, and in transplanting him to the New World it is by no means certain that he has not lost ground physically, without any proportionate gain in his mental development. The conditions of existence in temperate climates are such that negroes and mulattoes are especially apt to become affected with consumption and scrofula. This is a fact of common observation among physicians, and the statistics of the British army are very conclusive in regard to it. In the West India Islands and other English colonies, regiments of negro troops are maintained in considerable proportion to the whites, and it is found that, in Sierra Leone, the number of deaths from consumption is nearly the same for both the white and the negro troops, being about 6 per 1000 annually; whilst at Gibraltar, the deaths of the whites remaining nearly the same, those of the negroes from consumption are 43 per 1000, or more than eight times as numerous as those in a climate to which they are naturally adapted. But as if in compensation for this special susceptibility to consumption, the negro race is almost proof against malarious diseases, such as fever and ague, and until our last epidemic of 1878 and 1879, yellow fever rarely attacked members of this race in the United States, whilst it was terribly fatal to the whites. In Sierra Leone, the mortality per 1000 from malarious fevers was about two and a half for the negroes, and attained the enormous number 410 per 1000 among the white troops in a single year. Syphilis is another disease which is less frequent and milder in the negro than in the white race, and the horrible secondary symptoms, which add so much to the terrors of this vile malady, seldom persist and often do not appear in the black. Negroes are not able to resist the effects of low temperature as well as the superior races; whilst, on the contrary, they endure extreme heat much better.

One of the most remarkable facts in the domain of Biology, or the science of life, is the strange and fatal influence which the white race seems to exercise upon the inferior races, whose territories Caucasians have invaded. Nowhere has this melancholy, withering effect been more deadly than among our American Indians, many tribes of whom have been utterly blotted out of existence, and others in the far West are rapidly following them to the happy hunting-grounds, which constitute the red man's paradise. In Polynesia figures speak with touching eloquence, as, for example, in the Sandwich Islands, where Capt. Cook, a hundred years ago, calculated the population at 300,000, of which only 67,000, or about 22 per cent., remained in 1861. In New Zealand the fatality is even more appalling, only 56,000, or 14 per cent., of the 400,000 which filled that island a century ago now remaining.

In addition to the influence of race over the production of disease, there are great differences among portions of races constituting nations in this particular, and even parts of nations exhibit similar peculiarities.

### The Human Family of One Blood.

Prof. Agassiz's theory of the essential diversity of the human races is much disputed, and against this doctrine it is ably urged that men who compose the different races present a complete analogy in the accomplishment of the different actions of organic and social life, a singular unanimity existing respecting the principal laws of the animal economy, and the mode of performing the physiological functions. For example, the average duration of life is about the same in all the different races of man. This longevity varies only in consequence of external causes which bring about accidental and premature deaths, or as a result of influences which deteriorate the health and alter the organization, affecting thus more commonly all races in a particular climate. Again, the bodily temperature and the frequency of the pulse are about the same in all the various human races, and so are the establishment of puberty, and the advent of the critical period of change of life in females, of all races exposed to the same climatic influences.

Some observations of the author of this volume upon representatives of fourteen different nationalities, gathered in Philadelphia at the Centennial Exhibition, demonstrated the curious fact that the red blood corpuscles, so abundant in the vital fluid drawn from the veins of men of these different races, were almost exactly alike in size, and contributed an additional item of scientific evidence that "the Lord created of one blood all the nations of the earth."

The hygienic advantages enjoyed by any long established race in any particular country, are very important contributors to health, and should not be lightly thrown away by removal to distant situations, where corresponding disadvantages will probably have to be encountered. The indigenous inhabitants of a country are physically constituted in such a way as to be best adapted to that country, for the simple reason that, in a long course of years, families, the members of which are not so conformed to the requirements of the climate, temperature, soil, and so forth, will die out. Thus, individuals whose ancestors have for many generations resided in a particular region, are born and develop with their external conformation, as well as their internal constitution, temperament, idiosyncracies, and physiological habits, in harmony with the surroundings among which they are placed. Furthermore, the diseases from which they suffer, being the results of influences which environ them, and to which they have inherited a certain amount of insensibility from long custom, often differ in their character, their treatment, and their severity, from the maladies brought on by the same causes in persons who are more or less unaccustomed to their effects.

Some useful suggestions for individuals belonging to the different varieties of the human family above mentioned, in regard to their general



tendencies towards disease, may be drawn from the report on relations of race and nationality to mortality, furnished by the census bureau of the United States.

### **National Tendencies to Disease.**

Among the Irish we meet with a comparative exemption from fevers, and from diseases of the digestive and nervous systems, with a marked liability to constitutional diseases, such as consumption, and an extraordinary mortality from **Bright's disease of the kidneys**.

Among the Germans we observe a reduced mortality from general diseases of a constitutional type, and a decided liability to those of the febrile group, especially small-pox, showing, therefore, an exact reversal of the relations of the Irish to these two classes of maladies.

The English and Welsh enjoy a comparative immunity from affections of both the constitutional and febrile types, and a relative liability to **maladies of the nervous, circulatory, and digestive systems**.

The Swedes, Norwegians, and Danes show a marked liability to death from dysentery and diarrhœa, and an extraordinary mortality from febrile diseases, notably measles, scarlet fever, diphtheria, and typhoid fever.

### **Temperaments, and Hygienic Rules for Them.**

The temperament of any individual has a good deal to do with the character of his diseases, and exerts a powerful modifying influence upon the course, severity, and fatality of his complaints. Hence, the question of temperament, in former ages, attracted much notice, and is at the present day worthy of far more attention than is usually accorded to it, from both a medical and a hygienic point of view.

The temperaments are defined to be those constant differences between men which are compatible with the retention of average life and health, are due to a variation in the proportion and activity between the different parts of the body, and are important enough to modify the actions of the human system. In temperament, therefore, resides the specific difference which gives to persons or groups of persons their individuality, and in some cases it is difficult to distinguish between temperament and predisposition. Nevertheless, by careful observation, we can often discover the diseases to which a man is especially liable, with as much certainty as we can indicate the intellectual character of an individual from the shape of his features, the color of his hair and complexion, and the peculiarities of his pulse and respiration. It cannot be truthfully asserted that very clearly defined lines distinguish the temperaments from each other, because they shade into each other, as it were, somewhat as do the animal and vegetable kingdoms in nature. In this way certain compound temperaments arise, which exhibit characteristics of the elementary attributes out of which they are constituted.

One of the best classifications of temperaments is that adopted by

Devay, into four, which seem to be founded on well-marked natural differences. These are: first, the Sanguineous, or Sanguine; second, the Lymphatic, or Phlegmatic; third, the Bilious, or Choleric, called by some writers the Fibrous; and fourth, the Nervous temperament.

### The Sanguine Temperament.

The Sanguine temperament is characterized by great activity of the heart and blood-vessel system, and also of the lungs, so that the pulse is quick and strong and the complexion florid. The hair is red or brownish, the skin thin and fair, and the mind vivacious, cheerful, and hopeful. The person of sanguine temperament is bold and enterprising, but both physical and mental endurance are often lacking, and sometimes inconstancy is the prevailing trait. Charles the Second, of England, is said to have been a good illustration of this type. The diseases to which persons of this temperament are peculiarly disposed are those connected with the organs which carry on the circulation of the blood. That is to say, they are liable to both functional and organic diseases of the heart, aneurism, and to hemorrhages of various kinds. Contrary to the generally received opinion, some recent high authorities do not believe in the existence of any decided tendency of individuals of this temperament to inflammatory diseases, since activity of the circulation is not always favorable to affections of this character. It is, however, probable that inflammation, when set up by any exciting cause in persons of sanguine temperament, is much more apt to be of a violent type. Epidemic and malarious diseases appear to attack people of this temperament with more readiness than others, but this may in part be due to the recklessness of such individuals, which leads them to rush into danger without taking the ordinary precautions to preserve health. For the same reason it is, perhaps, more common to meet with venereal diseases among them, although this does not altogether account for such prevalence, as there seems to be an excessive degree of impressibility, which likewise renders the possessors of this temperament extremely liable to other contagious diseases, such as small-pox and scarlet fever. The following hygienic rules for individuals of sanguine temperament are worthy of close attention. 1st. Bleeding should never be resorted to except it is absolutely necessary, and then to very moderate amounts, for fear of establishing a habit requiring it. 2d. Food should be partaken of in moderate quantity, and it should not be of an exciting quality. Stimulating drinks, such as alcohol, coffee, and so forth, ought to be avoided. 3d. Physicians ought to prescribe frequent exercise, in order to bring into full play the entire muscular system, and expend by this kind of safety-valve the excessive richness of the blood, which is so rapidly renewed in consequence of the superabundant activity of the functions which manufacture it. 4th. Hot climates, hot weather, and small, close, ill-ventilated apartments, should all be carefully avoided, in order to

guard as much as possible against cerebral congestion in particular, and generally to repress the harmful manifestations of the sanguine temperament.

### **The Lymphatic Temperament.**

The Lymphatic or Phlegmatic temperament is directly opposite to the sanguine in almost every respect. The pulse and respiration are apt to be feeble and slow, the face pallid, the eyes wanting in brilliancy, the hair deficient in coloring matter. The whole form is rounded instead of angular, and wanting in that elasticity and energy which characterize the sanguine temperament. The same weakness and irresolution are observable in the mental operations, and the memory and power of application are feeble. Notwithstanding men of this temperament have not usually taken a prominent part in the affairs of the age in which they lived, they have often proved themselves very useful and trustworthy members of society. When rapid action is required, says Müller, the phlegmatic person is less successful, and others leave him behind; but when no haste is necessary, and above all, where delay is admissible, he quietly attains his object, whilst people differently constituted have committed error upon error, or perhaps been diverted from their course by their passions or appetites. The diseases to which individuals of lymphatic temperament are especially disposed are such as are due to debility and relaxation of the tissues, together with weakness of the circulation. Thus inflammations, particularly those of a low and chronic type, attacking in preference the mucous membranes, such as that covering the inside of the nose, throat, and lungs, are frequently encountered in subjects of this temperament. Scrofulous affections, such as degeneration of the lymphatic glands, tuberculous inflammations of the joints, tuberculous deposits in the lungs, and skin-diseases are common, as are also dropsical disorders; so that the onset of all these disturbances of health ought to be watchfully guarded against. Individuals of lymphatic temperament do not seem to be especially liable to malarious diseases, or to be the subjects of contagious affections, with the exception of influenza, to which they are as a rule particularly disposed whenever it is prevalent. The following principles should always be kept in view, not only in treating diseases which may arise in people of lymphatic temperament, but also in combatting the tendencies of the temperament itself. 1st. Particular attention should be paid to securing for the person a pure air, renewed frequently enough to retain its healthfulness. A country life in a dry, elevated region is to be strongly advised. 2d. Exercise should be regular, but not too violent, and accurately suited to the strength of the individual. 3d. Alimentation must be abundant, and largely composed of animal food; not, however, to the exclusion of fresh, wholesome vegetables. 4th. It is especially important that persons of lymphatic temperament should avoid exposure to those great causes of disease in our climate, Cold and Moisture, and pains must



be taken to attack all diseases when they are contracted at their very outset, although not with debilitating means, such as large bleedings or drastic purgatives. Tonics, both general and local, should be resorted to as early as possible.

### **The Bilious Temperament.**

The physical and mental characteristics of the Choleric or Bilious temperament are generally well defined and obvious. The complexion is apt to be dark or sallow, the hair black or dark-brown, the eyes black or hazel, the skin dry and rather harsh, the pulse strong, hard, and frequent, the respiration deep and full, the whole form tough and wiry; mentally, the men of choleric temperament are characterized by firmness, decision, and determination. Alexander the Great, Julius Caesar, and Cromwell are quoted as examples of this temperament, in which ambition is the governing passion, as love is in individuals of sanguine temperament. The diseases to which persons of this type are especially liable are those connected with the liver and other organs of digestion. Such people are more than others especially subject to malarious affections, such as the various forms of intermittent and remittent fevers, typhoid fever, and dysentery. Dyspepsia and internal congestions often attack them, and hemorrhoids or piles are not infrequent.

### **The Nervous Temperament.**

In this type of human structure the manifestations of nervous action give an impress to the whole body. The countenance is usually pale, and the features thin and sharp; the pulse is quick, small and frequent, the respiration active, the chest not large, the skin dry and rough, and the digestive functions performed irregularly. As the muscular system is imperfectly developed, fatigue easily overtakes persons of this temperament, who generally have quick and brilliant intellects, the operations of which, however, are not persistent, variety being constantly sought for. Women are much more apt to be possessors of this temperament than men, as it is often intensified by habit of thought or mode of life, and is seldom met with among barbarous nations, the whole spirit of civilized institutions predisposing to its formation. Among distinguished Americans, John Randolph, of Roanoke, was a notable example of this type. The diseases which are most apt to occur among individuals of nervous temperament are those having an intimate relation with the nervous system, such as chorea or St. Vitus' dance, hysteria, and insanity. In fact, the nervous temperament may almost be looked upon, in many instances, as a condition of disease, for the sensibility is so acute, and the whole body so readily thrown into disorder in consequence by slight causes, that it must often be considered an actual departure from perfect health. It has been observed that this temperament occurs more frequently

pure and without mixture than any of the others; that when met with in combination it is especially apt to absorb the other, or at least to largely predominate; also, that it frequently becomes more and more exaggerated as the individual advances in life. Its influence upon various diseased conditions may be summed up as follows: 1st. When any disease is about to develop in the system of an individual of nervous temperament, it is by no means rare for separate derangement of the nerves or brain, such as unnatural mental impressions or delusions, or even an attack of convulsions, to manifest themselves, sometimes to such an extent as to completely hide the original complaint, which is the starting-point of the whole trouble. Nervous diseases, of all their varied types, present themselves with less provocation and greater frequency among persons of this than of any other temperament. The hygienic rules for people of nervous temperament therefore are: 1st. Avoid with special care all the exciting causes capable of bringing into play this superabundant excitability of the brain and nerves, and especially those which take their origin in prolonged or intense action of the intellectual powers. 2d. It is quite as important to avoid an insufficient or imperfectly sustaining diet, as a too stimulating regimen, because the brain and nerves are at least as likely to be deranged if supplied with impoverished blood, as if the circulating fluid were too exciting in its quality. 3d. The skin should be kept in the best possible condition by the frequent employment of baths. 4th. In many instances it is absolutely necessary to spend much time in moderately energetic exercise, substituting physical and muscular activity for that of the brain. Persons of this temperament who are threatened with actual derangement of the brain or nervous system should, if possible, lead a somewhat laborious country life, instead of an intellectual one in any great centre of civilization.

### Compound Temperaments.

It very often happens that the temperaments are not so clearly defined that a particular individual can be said to possess the traits of one without also displaying attributes of another. Thus, we frequently meet with persons whose endowments in the way of temperament must be characterized by the terms Sanguineo-nervous, Sanguineo-choleric, and so forth. Or, if one of the combined temperaments decidedly predominates over the other, we may have to speak of a temperament three parts nervous and one part sanguine. The hygienic precautions against disease and the curative treatment of such individuals when sick, are to be carefully varied in accordance with the indications already given. Besides these, we have to consider certain conditions which may properly be ranked as exaggerations or degenerations of the temperaments; thus we observe, sometimes, the Plethoric state, which is an amplification, as it were, of the Sanguine temperament; the Obese, which is an overgrowth of the Lym-

phatic; and the Melancholic, which is an excess of the Choleric. In the plethoric condition, the face is full or bloated, the eyes somewhat congested, the features generally rather injected with blood than healthily florid, and there is a tendency to corpulence without due muscular robustness or energy. If a man in such a condition is subjected to any violent excitement or stimulation, there is great danger that some of the delicate vessels of the brain may give way, and the person fall insensible under a stroke of apoplexy; or, if this familiar catastrophe is averted, some inflammatory action may at any time be set up in some of the overburdened digestive organs, which, even if it does not prove fatal, lays the foundation for a chronic malady, which renders the remainder of life scarcely worth living. The great means of preventing the onset of such a state of affairs in the animal economy may be taught in a very few words—moderation in all things; or, if the temper leads to excess, let it be only in exercise, especially walking.

There is another classification of temperaments, which, without being firmly established, has yet gained sufficient popular attention to render it worthy of a brief mention. According to it, the number of temperaments is only three, namely: 1st. The Motive, which is characterized by a superior development of the combined bony and muscular systems. 2d. The Vital, distinguished by a predominating vital or nutritive system, consisting of the heart, lungs, and digestive apparatus. 3d. The Mental temperament, in which the brain and nervous system are the controlling powers. In this new arrangement the nervous temperament is retained almost unchanged, except in name, as the Mental temperament; the sanguine, bilious, and lymphatic are grouped together as the Vital temperament; whilst muscular, vigorous individuals of the bilious and sanguine temperaments are selected out to form a new class, entitled the Motive temperament. This classification does not appear capable of guiding any one as usefully in the avoidance and treatment of diseases as the older plan, and is probably, therefore, much less valuable from a hygienic point of view.

### Constitution.

Certain writers upon hygiene have apparently confounded constitution with temperament; but there is little doubt that every one is endowed with a definite constitution, which is the essential condition of his individuality, and may be associated with any one of the temperaments. Constitution therefore includes, according to this view, most of the various influences which modify the action of causes of disease. What is called Idiosyncrasy, as will be explained presently more in detail, depends upon the degree of development or of activity displayed in some particular organ or apparatus of the body. Temperament depends upon the preponderance of one of the great systems of organs, as the Sanguine tem-



perament upon the heart and blood-vessel system, or the Nervous upon the brain, spinal cord, and nerves. A man's Constitution, however, is the expression of his individuality as a whole, and into this expression of his place among his fellow-men as regards his physical nature enter the degree of his muscular strength, the perfection with which his different bodily functions are accomplished, the amount of resistance to the causes of disease, the intensity of his endowment of life-force, and, as a consequence, the length of his duration of existence. Idiosyncrasies, then, are founded upon peculiarities of single organs; temperaments upon peculiarities of general systems of organs; constitutions upon peculiarities of individuals in their entirety. Hence, the two constitutions to which it is customary to refer, namely, the vigorous and the feeble, or the Strong and the Weak, include a great variety of shades of difference in strength and delicacy. The class of men blessed with vigorous constitutions comprises all those whose general vitality is much or little above the average vitality of the whole human race, whilst those compelled to labor under the disadvantage, in the struggle for existence, of weak constitutions, are the ones whose share of vigor is less than the average inheritance of mankind. The life-force, of which constitution is thus a measure, is by no means an abstract entity, but the result of all the actions which are carried on in the animal economy of each particular individual. It has been found that, up to a height of six feet, the stature of a human being has a nearly constant relation to the capacity of his chest, and that, therefore, other things being equal, a man's stature is a useful guide, in a general way, to the vigor of his constitution. Human beings only maintain the equilibrium of health by constantly reacting against the forces of external nature, and the vigor and endurance of this reaction in opposition to outside injurious influences is according to the constitutional strength. Now, the forces of nature which act upon our bodies are by no means constant, either in their intensity, their duration, or the rapidity with which they succeed one another; but notwithstanding their variations, they have a latitude included between two fixed extremes of which we can calculate a mean, and so determine the average resistance which men must oppose to their power. For example, the temperature of any particular climate varies between a certain pretty constant highest and lowest point, offering an annual average which is the measure of the amount of heating-power man must possess, in order to maintain his animal temperature in that particular latitude. As long as the external influences of the weather do not exceed the ordinary limit of their vicissitudes, the resistance which man needs to oppose to them is only measured by the usual development of his constitution; but if they surpass the ordinary margin of these variations, the human system must react against them with a proportionately uncommon energy, developing a correspondingly greater force, and, if the struggle is long continued, can

only avoid exhaustion by calling in to its aid reinforcements from the sciences of hygiene and medical treatment. Individuals of weak constitution succumb much more easily to privations and hardships than those of more vigorous structure; and yet, so great is the assistance which careful attention to diet, clothing, exercise, and so forth, can give to the natural vital force of the individual, in resisting the innumerable causes of disease, that some years ago a curious and instructive book was written on the advantages of a feeble constitution. One great reason that feebly-constituted persons are more prone to disease upon slight exposure to disturbing influences is, that the circulation of the blood in such people is weak and languid in the extremities, and consequently the temperature is not kept up to the normal standard, unless external circumstances are favorable. Hence, such individuals suffer severely from attacks of disease, brought on by exposure to cold and wet, which a person of strong constitution would pass through without injury. It is very much with man as it is with an artificial machine, such as a steam-engine, as I have already suggested, or a locomotive. If the latter is well made and of good material, the several parts strongly put together and working in harmony with each other, it will resist hard usage far better than one which is made of bad materials, and in which the different parts are not well proportioned, and are constructed without due regard to the work they have to perform. A bad constitution does not necessarily predispose to any particular disease, but renders its possessor more liable, as a rule, to every disease, and less likely to recover from severe illness when he is attacked. Temperament, on the other hand, may improve a person's chance of recovery, since, for instance, a man of marked sanguine temperament might get better from an attack of scurvy which, in a lymphatic person, would prove fatal.

### **Improvement and Deterioration of Constitution.**

To a certain extent, a weak constitution may be strengthened by proper attention to hygiene in early life. A child born in poverty and reared under circumstances unfavorable to securing a full development of the organs of the body, such as insufficient clothing, light, food, and fresh air, will in most cases grow up to be a feeble adult, if it attains maturity at all. A brother of that same child, inheriting exactly the same tendencies from its parents, may, however, by having the external conditions altered, at a sufficiently early period of its existence, in a favorable manner, grow up to be a man of strong constitution. And even at a late epoch of life, something can be done by a persevering application of hygienic measures, to invigorate a constitution which, throughout childhood and youth, has been feeble, in consequence of its being subject to unfavorable surroundings at first.

On the other hand, it should never be forgotten that a constitution

which is naturally strong may be terribly enfeebled by excesses, or a persistent violation of the rules for preserving health. Long-continued exposure to heat, cold, dampness, and malaria; habitual indulgence in alcohol, even when not carried to excess; inordinate sensual gratification of any kind, loss of sleep, deprivation of food, and frequent attacks of disease, will sooner or later break down the strongest constitution. Since it is in early childhood that the constitution of an individual is most easily made or marred, it is the duty of every parent and guardian to watch over the developing constitutions of those under their care with the most jealous attention. A strong meat diet, or at least an abundance of milk, eggs, and other animal food, the solution of which should be aided by artificial pepsin if necessary, as will be pointed out more in detail in the section upon food, are very important under these circumstances. Many weak and puny children develop into adults of feeble constitutions, because they are nourished imperfectly upon a vegetable diet, with the diluted milk which, unfortunately, forms the only supply attainable for city-bred children in many cases. Where, as frequently happens, children of weak constitutions show an invincible distaste for animal food, they should be compelled to take as medicine one or two ounces of beef extract, or beef essence, or double that quantity of strong beef soup, daily, a precaution which has repeatedly been crowned with the most gratifying results.

Persons of originally sound and robust organizations may, by judicious and guarded exposure to cold and wet, become strengthened by the development of their powers of resistance to these antagonistic agencies of nature; but those of feeble constitutions are more apt to be overcome than to conquer under such circumstances, during the process of hardening themselves, the experiment too often terminating like that of the miser, who undertook to educate his horse to live without eating, by gradually diminishing his amount of food, and was much encouraged at the prospect of success, until, just as he got the animal down to one straw a day, the poor beast unluckily died.

### **Idiosyncrasy and its Bearing upon Hygiene.**

When a person is affected by external agents, such, for example, as a particular article of diet, in a way peculiar to himself, and different from the generality of mankind, that peculiar susceptibility is called an idiosyncrasy. The study of idiosyncrasies, as regards different external influences causing diseases, is obviously a very important one, from a hygienic point of view; and, in respect to remedies employed in curative medicine, is often of the highest value. As illustrations of idiosyncrasies in regard to diet, may be mentioned the fact that some people cannot eat strawberries without suffering from a troublesome species of nettle-rash; others are similarly affected by indulging in shell-fish, which also brings on in cer-



tain persons a form of cholera morbus; and severe nettle-rash has been brought on by eating boiled cauliflower, or violent diarrhœa proved the result of eating even a minute particle of egg, no matter how it was prepared. These and other like peculiarities, some of which seem very curious, are sometimes inherited and sometimes acquired, and two or more may exist in the same individual, as, for example, one connected with the heart and blood-vessel system, and another with the digestive apparatus. Idiosyncrasies, especially those which are acquired, may sometimes be conquered by persevering efforts to that end. Thus, the case is recorded of a gentleman who, for many years, could not eat soft crabs without suffering from diarrhœa, yet as he was very fond of this dainty but dangerous dish, he persisted in eating crabs, until, after a long struggle, during which his digestive organs became, as it were, acclimated to the disturbing action of the shell-fish, he succeeded in overcoming the tendency. It is probable that almost every human being is the subject of one or more idiosyncrasies in respect to particular kinds of food or mixed dishes, which can only be found out by trying the experiment, and then making a careful note of the favorable or injurious effects. Where the idiosyncrasies are at all strongly marked, their possessors are soon taught by painful experience how severe are the punishments for violating the laws of their being, by trying to do as others do in these particulars. Idiosyncrasies in regard to drugs and medicines are very common, and an exact understanding of their nature and limitations forms one of the most important parts of the self-knowledge which it is the highest earthly interest of every human being to study to obtain. For example, one hears of a great many fanciful and a few real idiosyncrasies in regard to laudanum, opium, and morphia. In cases where there is a real inability to bear one of these narcotics—and there are, unfortunately, people who, not being able to gain the inestimable relief from pain which opium affords, are truly to be pitied—some other anodyne must be substituted, generally with much less beneficial results. In many instances, however, no hurtful effect is produced, unless the patient is aware that he is taking opium in some of its various preparations, and in such instances it is surely right to conceal the fact from him, at least until after he has experienced the benefit. Another idiosyncrasy which is occasionally met with is in regard to calomel or mercury, which in any form produces upon some few people salivation, even when extremely minute doses are administered. Such an idiosyncrasy is also an unfortunate one, although far less so than that preventing the use of opiates; and as neither of these peculiarities can be foreseen, and can only be learned by experience, the first dose of these powerful remedies which any human being ever takes in his or her life should be a very small one, and its effects watchfully observed.

Idiosyncrasies may be temporary only when they depend upon some

condition of the system which, whether natural or diseased, is only transitory. Illustrations of this variety of idiosyncrasy are met with during the period when children are cutting their first teeth, during pregnancy, and also about the time of the commencement and cessation of the monthly discharge in females. These idiosyncrasies are often very important in their effects upon the health of the individual, and should be respected with the most scrupulous care; but when the disturbed condition which has given rise to them disappears, the idiosyncrasy, as a general rule, but with some notable exceptions, also passes away. Some of the conditions often called idiosyncrasies are doubtless due to partial mental derangement, but they should not be thus confounded.

All idiosyncrasies ought to be carefully respected, not only in the management of an individual's health, but also in the treatment of his diseases. To attempt to combat them during sickness is to run the risk of transforming them into morbid sympathies, or perhaps grave complications of the existing malady. Even during a perfect sanitary condition, our efforts to modify an established idiosyncrasy must be made slowly, gently, and, as it were, by roundabout means, especially by instituting new habits of life. In such a manner only can we hope to overcome or diminish, with advantage, an idiosyncrasy which is disagreeable, inconvenient, or injurious to the well-being of the animal economy in which it is manifested.

### **Age as Modifying Health and Disease.**

Perhaps of all the influences whose action upon our bodies we have to carefully consider, both in avoiding and curing disease, there is none more important than age. The period of life brings with it special dangers as well as special immunities from disease, and affects—powerfully affects—the course and termination of nearly all maladies to which our flesh is heir.

As Emerson says, all men carry seeds of all distempers through life, and we often die without developing them, such is the affirmative power of the constitution; but if a man is enfeebled from any cause, some of these sleeping seeds may start and open. Meantime, at every stage we lose a foe. It were strange, indeed, if a man should turn his sixtieth year without a feeling of immense relief from the number of dangers he has escaped. When the old wife says, "take care of that tumor in your shoulder, perhaps it is cancerous," he replies with indifference, "I am yielding to a surer decomposition." "The humorous thief, who drank a pot of beer at the gallows, blew off the froth because he had heard it was unhealthy; but it will not add a pang to the prisoner marched out to be shot to assure him that the pain in his knee threatens mortification."

During our whole lives the fluids and tissues of the body are constantly undergoing change, new matter being deposited and old removed with

ceaseless activity. And yet this movement of materials is not perceptible to the eye, even when aided by the best optical instruments which manufacturers of microscopes have constructed for assisting the human vision. It only becomes so whenever it experiences any disturbance, whether this be an obstruction or an exaggeration of its natural rate of progress. With all our advantages, we have never yet been able to demonstrate to the eye the nutritive process of the muscular fibre in the tail of a living tadpole, or to detect the quiet coming and going of materials in an adjacent connective-tissue cell. As long as these objects continue to present a certain aspect known and defined to the minutest point and line, we receive this fixed appearance as a proof that the wonderful changes connected with nutrition have in themselves a natural relation to each other. And yet, throughout, this complex machine, in which the law is fully carried out that force is generated only by decomposition, constantly undergoes a change in all of its constituent parts—from infancy, through youth and maturity, to old age and decay. Every muscular movement of any portion of the body, every pulsation of the heart, every thought which emanates from the brain, is accompanied by the destruction of a certain amount of tissue. During maturity, as long as food is supplied in abundance and the digestive functions are not disordered, reparation proceeds as rapidly as decay, and life is the result. But it is far otherwise when the limit of three-score and ten is reached, or, by reason of strength, for a few years exceeded.

The animal body is, therefore, undergoing a continual change. The hair of yesterday is not precisely the hair of to-day; the muscle which extends the arm is not identically the same muscle after as before the action; old material has been removed, and new has been deposited to an equal amount; and though the weight, form, and chemical constitution, as well as the microscopical characters, have been preserved, the identity has been lost. So long as these two compensating actions of disintegration and repair exactly balance each other, life continues. If it were possible to adjust the repair to the waste, so that neither would be in excess—as must have been the case in Methuselah's body—there is no physiological reason why life, if protected against accidents, should not continue indefinitely. But with our present knowledge this seems to be beyond our power, and consequently there comes a time when, under the most favorable circumstances, decomposition becomes predominant, and death from old age results.

The life of man has been variously divided by different authors into artificial periods or stages, the limits of which are by no means accurately defined, although the Seven Ages of Man are pictured with such wonderful skill by the great English dramatist, that it seems as if those grand portraits must hold a place in the study of humanity, at least as long as the Anglo-Saxon race endures. From a hygienic point of view,



however, a natural division, based upon the physiological course of the life of man, is more convenient as well as more useful. In accordance with this principle, we divide the life of man into three periods, as follows: 1st. The period of Increase, in which the formation of tissue predominates over decay; this stage extends from birth to about the twenty-fifth year, varying in accordance with sexual and individual peculiarities. 2d. The period of Maturity, in which the processes of regeneration and waste counterbalance each other; an equilibrium of antagonistic forces generally maintained from about the twenty-fifth to the thirty-fifth year. 3d. The period of Decline, or Decay, during which the tissues are not repaired as fast as they are broken down, and we witness a disturbance of the balance between these two operations, which goes on, increasing gradually with more or less rapidity, from the thirty-fifth year to the extreme limit of human life. Each of these three periods is marked by strong peculiarities of both organization and action, and they all exhibit immunities from some diseases and susceptibilities to others, which are only to be accounted for by a reference to the physiological condition characterizing each stage of progress from infancy to old age, and which is repeated in generation after generation of our race with unvarying uniformity. As the lamented President Lincoln's favorite poet tells us—

“ We are the same things that our fathers have been,  
We see the same sights that our fathers have seen ;  
We drink the same stream and we feel the same sun,  
And we run the same course that our fathers have run.

“ The thoughts we are thinking our fathers would think,  
From the death we are shrinking from they too would shrink ;  
To the life we are clinging they also would cling,  
But it speeds from the earth like a bird on the wing.”

Dr. Wilson, in the introductory chapter of his excellent little volume upon “ Healthy Life,” illustrates the dangers of different ages by reference to Addison's beautiful allegory of the “ Vision of Mirza,” which, weird and shadowy though its outlines be, represents very vividly what has been called the march of a generation through life, and the casualties under which so many succumb, even in the first few stages of existence. According to the allegory, Mirza, looking eastward from the highest pinnacle of the rock upon which his guide had placed him, beheld a huge valley and a prodigious tide running through it. The valley he was told was the Vale of Misery, and the tide of water, which rose out of a thick mist at one end and lost itself in another thick mist at the other, was but the part of the great tide of eternity, called Time. Peering across this shoreless ocean, Mirza discovered a bridge standing in the midst of it, but shrouded at either end by a dark cloud, and this bridge, he was in-



*STATUE OF HERCULES—The Ideal of Physical Strength.*





formed, was Human Life. Being asked to survey it more closely, he found it consisted of three-score and ten entire arches, with several broken arches, which, added to those which were entire, made up the number to about one hundred. Over this bridge he beheld multitudes of people passing, and many of the passengers dropping through into the great tide which flowed underneath, for "there were innumerable trap-doors which lay concealed in the bridge, which the passengers no sooner trod upon than they fell through into the tide and immediately disappeared." He noticed, further, that these hidden pit-falls were set very thickly at the entrance of the bridge, so that throngs fell through as they came out of the cloud. The trap-doors became fewer towards the middle, but multiplied and lay closer toward the end of the arches which were entire. Lastly, over the broken arches there were some persons, though very few, indeed, that continued a kind of hobbling march, but fell through, one after the other, being quite tired and spent with so long a walk. It is true that the trap-doors in this allegory suggest a rather fatalistic view of the deadly ills which flesh inherits in this world of suffering and death; but in Addison's day, and indeed until quite recently, disease was considered as inevitable, far more than avoidable, curable it might be in some instances, but rarely admitting of prevention or control. The very few who reached the broken arches which lay beyond the allotted three-score and ten were looked upon in pretty much the same light as soldiers who had escaped the shot and shell of a thickly-strewn battle-field. Now, however, we are beginning to realize that most of these pit-falls may be avoided, and the trap-doors made secure and passable, so that the many, instead of the ever-lessening few, may travel towards the broken arches—which imperfect arches sanitarians, when fully sustained in their good work by public opinion throughout the community at large, will we hope rebuild in the next hundred years, and make strong and firm.

The late Dr. Farr, of England, compiled some years since a very instructive table, showing the progress of an English generation of one million persons through life, part of which is as follows:

#### Liability to Death at Different Ages.

|                     | From                             | Deaths. | Per cent. |
|---------------------|----------------------------------|---------|-----------|
| Period of Increase. | Birth to age of five years.....  | 263,192 | .26+      |
|                     | In a healthy country.....        | 175,410 |           |
|                     | In a crowded city.....           | 460,370 |           |
|                     | Five to ten years.....           | 34,309  | .03+      |
|                     | Ten to fifteen years.....        | 17,046  | .02—      |
|                     | Fifteen to twenty years.....     | 21,813  | .02+      |
|                     | Twenty to twenty-five years..... | 28,705  | .03—      |
| Period of Maturity  | Twenty-five to thirty-five.....  | 62,052  | .06+      |

|                     | From                                   | Deaths. | Per cent. |
|---------------------|----------------------------------------|---------|-----------|
| Period of Decline.. | Thirty-five to forty-five.....         | 69,078  | .07—      |
|                     | Forty-five to fifty-five.....          | 81,800  | .08+      |
|                     | Fifty-five to sixty-five. ....         | 112,186 | .11+      |
|                     | Sixty-five to seventy-five.....        | 147,905 | .15—      |
|                     | Seventy-five to eighty-five.....       | 122,559 | .12+      |
|                     | Eighty-five to ninety-five.....        | 36,412  | .04—      |
|                     | Ninety-five to one hundred .....       | 1,930   |           |
|                     | One hundred to one hundred and eight.. | 223     |           |

The author of this table makes many interesting deductions from it and his accompanying researches, but want of space compels the omission of most of them. It is especially worthy of note, however, that the greatest mortality by far is met with among young children, the deaths during the first year numbering 149,493, or about fifteen per cent., and exceeding the deaths of adults in any ten years of the period of decline. Great as is the effect of feeble organization in the young infant as a predisposing cause to fatal disease, the difference of external circumstances and sanitary conditions exercise a very real influence on life, disease, and death in childhood; this is most conclusively shown by the facts that of a 1,000,000 children born in the healthy country districts of England, only 175,410 die during the first five years of life, whilst out of 1,000,000 unfortunate babies born in the Liverpool district, which serves to represent the most unfavorable sanitary conditions of cities, 460,370, or nearly half the entire number coming into the world, die in the five years following their birth. After the dangers of infancy and childhood are passed, the period of youth is, as shown by the table, the most healthy time in a person's life, fewer deaths occurring in the five years from ten to fifteen, and in the ten years from ten to twenty, than in any other like periods, until advanced old age is attained, and the numbers cut off begin to fail for want of material, which the scythe of the great Reaper, Death, can find to operate upon. As an example of the deaths in fully-developed human beings, let us next glance at the record of mortality during the period of maturity, that is to say, between the ages of twenty-five and thirty-five. Out of the 1,000,000, about 634,000 reach the former age, and nearly 580,000 the latter. This period is the athletic, the poetic age, it is the prime of life. Two-thirds of the women are married, and at the close of this period, that is, at thirty-three or thirty-four years, is the average time when husbands become fathers, and wives become mothers, and the new generation is put forth; at this age Consumption is by far the most fatal disease to both males and females. Passing on now to the period of advanced Decline, we come to the age of fifty-five years and upward. To this epoch, nearly the middle of the possible lifetime of humanity, in its present state about 421,000 attain. One thing especially observable is, that the rate or degree of danger to life, which has hitherto

advanced slowly, now increases at so much faster a pace that, although the number of lives grows annually much less, the number of deaths increases in every one of the next twenty years, that is, until the seventy-fifth year of life, and is sustained at about the same figure for ten years after that time, until at last, in the distance, the living all resolve into the elements from which they came. The seventy-second year of life is that in which the greatest number of men die, and this may have been the reason that the royal Psalmist of Israel placed the limit of human life at three-score and ten, although, when proper hygienic precautions are observed, and in some rare cases in spite of their neglect, this Biblical term of existence is often exceeded. The 38,565 aged pilgrims who pass the eighty-fifth year of life are no longer what they were, their strength is fading away and they succumb to slight injuries, to cold, heat, want, or to attacks of illness, which in their earlier years would have been easily shaken off. Only 2153 out of 1,000,000 live to the age of ninety-five, and 223 to one hundred years. Finally, according to Dr. Farr's table, at the age of one hundred and eight, the last solitary survivor of our million of human beings expires.

#### **Tendencies to Disease at Different Ages.**

A great disposition exists, during the first five years of the period of increase, to maladies of the nervous system, and this is at its height during the first dentition or cutting of the teeth. Convulsions due to irritation and inflammation of the brain and its membranous envelopes are, accordingly, of common occurrence. This excessive irritability of the brain and nerves, in the first five years of existence, also gives rise to many diseases of the stomach, bowels, and associated organs, and the lungs in very young children likewise display a strong tendency to inflammatory affections. Hence pneumonia or inflammation of the lungs, and bronchitis or inflammation of the bronchial tubes, are readily induced by very slight changes of temperature. Croup is particularly a disease of early childhood, the tendency to it diminishing after the third or fourth year, about which time it is most decided. Scarlet fever, measles, whooping-cough, mumps, and other contagious diseases are, as a rule, far more liable to attack children than grown-up persons, and small-pox is much more fatal to the young than to adults. In very young infants small-pox is particularly deadly, but it is often a great comfort to anxious parents to know that infants, during the first year of life, especially whilst nursing, are less apt to take the contagion of the various diseases above-mentioned than those who are older. Among the surgical disorders, hernia or rupture may be mentioned as a disease which is much more frequent among children, as a primary disorder, than adults, and umbilical hernia or rupture at the navel is almost always a disease of early life.

Taking the whole world over, it is believed that about one-tenth of all



the children born perish in the first month of their existence, and at the termination of the first year after birth, only about three-fourths remain alive. Under especially unfavorable circumstances, as for instance in the foundling departments of almshouses, nine-tenths of all the poor little innocents have been sacrificed to want of proper care.

In the latter part of the period of increase, extending from the time of puberty, in the twelfth or fourteenth year, to the twenty-fifth year of life, the deaths are largely made up of those from the consumptive and scrofulous maladies, which about this epoch lose the comparative latency and become active. As remarked by the distinguished physiologist, Dr. Carpenter, it is a very significant circumstance that, of the many specimens of young monkeys which have been brought alive to England, not one had, up to the time he wrote, survived its second dentition, and in almost every case it was by consumption or other tubercular disease that their lives were thus prematurely cut short.

#### **Health during the Period of Maturity.**

During the period of Maturity, that is, from about the twenty-fifth to the thirty-fifth year of life, the innate tendencies and predispositions to disease are least active, and it can hardly be said that age has any but a favorable influence in modifying accidental disturbances of health. Since this epoch in every human being's life is that of all others in which typically perfect organization in perfect action is displayed, a great object with every wise young man or woman will be to postpone the oncoming of the third period, that of old age, as long as possible. A systematic plan for maintaining this most desirable equilibrium between the processes of waste and repair to its utmost limit ought to be worked out for every individual, in accordance with personal idiosyncrasies, temperament, constitution, and so forth, from certain general principles, briefly such as the following: In the first place, all of the mental and physical faculties should be duly exercised each in its turn, but without any of them being overtaxed. Second, an amount of sleep sufficient to secure their complete renovation after exhaustion by fatigue must be regularly allowed. Third, an adequate, but not excessive, quantity of wholesome food must be taken into the stomach at suitable times without too long an interval between them. Fourth, the bodily functions, whose duty it is to convert the appropriate portions of our diet into blood, and that other set of functions by which the blood is kept pure, comprising the elaboration and discharge of urine, perspiration, and matters from the bowels, must be duly performed. And lastly, all such noxious agents as foul air, strong alcoholic liquors, tobacco in excess, and malarial emanations, should be carefully avoided. If these precautions are faithfully observed, and if, on the one hand, there be no constitutional predisposition to disease, nor on the other, any effective exposure to external causes capable of deranging

health, such as heat, cold, contagion, and the like, we may fairly expect that the bodily and mental vigor will be maintained with but little deterioration through a long succession of years. Among those conditions which commonly tend to bring on a premature decline, and which should, therefore, be most watchfully guarded against, are, on the one side, excessive exertion, either of the mental faculties or of the physical energies, especially of the generative power; or, on another side, undue indulgence in food, in stimulating drinks, or in any practice which has a tendency to disturb the organic functions, either by exciting them to an excessive activity, or leaving them in an unnatural torpor and repose. Every one who in any of these modes may live *too fast*, is almost certain to be compelled to pay the extortionate price of usury upon his borrowed pleasure, in the great abbreviation of his term of vigorous activity, which may be perhaps brought to a sudden and final close by paralysis or other fatal disorder, or may be prematurely reduced by a more gradual decay. And this tendency will be more decided, of course, the greater the amount and the more extensive the combination of those departures from the laws of health which give rise to it.

#### Diseases of the Third Period, that of Decline.

In the mournful stage of decay, and just in proportion to the condition of advancement in that decline, there is an obvious diminution of the whole vital power of the human system, as shown in the entire absence of any attempt at new development, the less perfect and more tedious manner in which loss of the substance of the body from wounds, or injury, or disease is recovered from, and in the gradual deterioration of the teeth, the hair and, in fact, of all parts of the frame. The forms of degeneration most frequently met with in advanced age are the Fatty, in which the active substance of an organ—for example, the muscle-cells of a muscle, or the nerve cells of the brain—are replaced by inert drops of oil; and second, the Calcareous or Chalky, in which a similar substitution of chalk-like matter occurs. The former is extremely apt to show itself in those organs the integrity of which is peculiarly important to health, and whose deterioration interferes directly with the vital properties residing in the tissues of which they are made. This we notice especially in the walls of the heart; and, of course, just in proportion as the muscle-substance in this most important organ is replaced by powerless fat, must the contractile power of the heart, and its capacity for doing its full duty in propelling the blood over all parts of the system, be diminished. So, again, we notice the same degeneration in the liver, in the kidney, and other glandular organs, the natural secreting action of which is necessarily impaired, in exact proportion to the substitution of fat for the proper gland structure. This form of degeneration may also lead to serious derangements of the vital functions by its interference with the purely

mechanical operations of particular portions of the body. Thus, fatty degeneration of the walls of the blood-vessels, whereby they become weakened in small spots and are burst through by the blood-pressure, is one of the most frequent causes of those hemorrhages inside of the skull which, pressing upon the brain, give rise to the symptoms of a fit of apoplexy, or to the various forms of palsy or paralysis which are so common among old people. The peculiar brittleness of the bones often displayed in advanced life is usually due to the occurrence of fatty degeneration. Calcareous degeneration is especially met with in parts of the body remarkable in youth and middle life for their flexibility, which indeed is a most important element in the due performance of their functions. For example, in old age it is often the case that the cartilages of the ribs become ossified, so as to seriously interfere with the free play of the walls of the chest, and consequent proper expansion of the lungs in carrying on the vital process of respiration. Similar deposit in the substance of the cartilage lying between the vertebræ which make up the spine or back bone, must obviously interfere greatly with the movements of the spinal column, and may finally lead to the entire prevention of assuming the erect position. A large amount of this kind of change may go on, without any dangerous obstruction to the vital operations of the human frame upon which life directly depends, although it tends, of course, to curtail the animal power and activity to a very great extent. When, however, calcareous degeneration attacks the heart or larger blood-vessels, as it very often does in advanced life, and especially when it involves the valves of the heart, its effects are very serious, very painful, and frequently very fatal, as will be explained more fully when treating of cardiac valvular diseases.

All the various modifications of these two forms of degeneration, the fatty and the calcareous, are favored and intensified by certain varieties of diet, habits of life, and so forth, which should be scrupulously avoided by every one in whom such a tendency appears. When partially or fully developed, they involve the restriction or limitation of many of the bodily functions and forces which must be carefully observed and obeyed, or health, and perhaps even life itself, will inevitably be sacrificed.

With the advance of old age, then, the whole human body becomes progressively more and more unfit for the performance of its vital functions, and a gradual weakening is usually observable in the mental as well as in the physical powers. This diminution of activity in the muscular and nervous systems interferes with the capacity for physical exertion, and hence, as remarked by Dr. Carpenter, there is on the one hand a marked diminution in the demand for food, and on the other a parallel decrease in the rate at which the processes of excretion are carried on, as is seen especially in the reduced exhalation of that deleterious agent, carbonic acid, from the lungs, and that poisonous product, urea,



from the kidneys of old people. In accordance with all these reductions, there is a markedly diminished ability for sustaining the heat of the body, the temperature of which becomes liable to dangerous depression from external cold. This retardation of vital activity gradually becomes more and more decided, until, like a clock which has run down, if neither accident nor disease intervene, the vital current stops of itself. The formative power of the body seems to undergo a progressive exhaustion until no assistance from artificial heat, no extra supply of the most nutritious food, can further avail for the production of new tissue to supply the place of that which is worn out. The energy of the muscular and nervous systems gradually declines, until at last even those actions on which the respiration and circulation depend can no longer be performed; and with the cessation of these functions, of course, the life of the entire body becomes extinct. Allison, in his *History of Europe*, states that some of the most remarkable instances of longevity in modern times have been among the West Indian slaves, one of whom is reported to have attained the age of one hundred and eighty years. Demetrius Grabowsky, a Polish shepherd, died, it is stated, in 1832, at the age of one hundred and sixty-nine years; and Henry Jenkins died at Bolton, England, in the seventeenth century, at the same good old age, according to the chroniclers, of one hundred and sixty-nine.

Most earnestly is it to be wished that the minds of the younger readers of this book could be impressed with half the due conviction of the importance to each one personally and individually, of prolonging the period of maturity by every means in their power, the most important of all being for them to avoid *now*, in the period of their growth, doing aught which will tend to exhaust their vital energies, just when twenty or thirty years hence circumstances—perhaps for the first time in their lives—relent a little, and give them a chance, after a long, hard struggle, to accomplish something in the world, and make some mark upon their age and generation. Depend upon it, all the honors and emoluments they may hope to win will prove naught, and less than naught, if the period of decline arrives before such compensations for hard work and patient endurance come. As sure as the sun shines, these rewards will elude or speedily escape their grasp, no matter how justly deserved, before they have had a fair chance to enjoy them, if they neglect the warnings of experience against hastening on, by any present and future imprudence or folly, the premature advent of this mournful period of Decline.

### The Diseases of Old Age.

Advanced life constitutes a condition which approaches so closely, if not to illness, at least to morbid tendency, that the ancients were not far wrong when they declared that "old age is itself a disease." In infancy, as already mentioned, the very softness and impressibility of the tissues

and organs is a cause of disturbance of health; whilst in the old man, a diametrically opposite state of the body conduces to the same evil result. For the infant, says Bichat, everything is acutely exciting; for the old man, everything is blunted and covered, as it were, with moss. The diseases to which old people are particularly liable are Apoplexy and Paralysis or Palsy, indirectly produced, as already explained, by the fatty or calcareous degeneration of the arteries of the brain; Heart-disease, arising from similar changes developing in the heart itself, or in the main blood-vessel or great aorta within the chest; and Asthma, or chronic Bronchitis, resulting from like alterations in the blood-vessels which carry the vital fluid to the lungs. But besides these and many other maladies of minor frequency, it is to be observed that the fatality of nearly all dangerous diseases is greatly increased in advanced life. Thus, for example, pneumonia, or inflammation of the lungs, from which nine out of ten recover in early life, probably proves fatal to a majority of those over sixty years old when they are attacked, whilst after seventy, recovery is a rare exception to the general rule. On the other hand, old age is favored with certain immunities from disease and from suffering of no small value. Eruptive fevers, typhoid fever, and consumption are uncommon, although an old man is not absolutely safe from their attacks, Louis XV., for instance, dying, as is well known, of small-pox at the age of sixty-five. Very frequently, pneumonia in the aged, though far more fatal, is much less painful than in youth or in the prime of life, and the same tendency is shown in the passage of a gall-stone, which, instead of the horrible agony of bilious colic in a strong man, may occur in the aged with only moderate discomfort in the region of the liver, a little vomiting and fever, and a slight yellowish hue of the skin.

### **Sex as a Modifying Power in Disease.**

Although many disturbances of health occur equally among males and females, there are many others which are greatly influenced by sexual peculiarities, and a few which are necessarily peculiar to men and women, as such, respectively. The diseases peculiar to the male sex are, of course, those of the masculine reproductive apparatus, and comparatively few in number; those maladies peculiar to women are more numerous as well as more important.

One of the first things to be observed in regard to the influence of sex, is that it seriously modifies the mortality of new-born infants. On account of the greater average diameter of the head, and the consequently increased difficulty of entering the world through the pelvic straits of the mother, nearly one-half more boys than girls are still-born. Probably, from the same cause, the death-rate of boys to girls is as three to four in the first two months of life; but during the next three months this proportion is reversed, the deaths among females being more frequent;



and after the eighth month, for some time, hardly any difference can be observed. Subsequent to the age of two years, and through the period of puberty until the twenty-first year is attained, more girls than boys are cut off; but from twenty-one to twenty-six death again predominates among the males. After this epoch again, and through the child-bearing period, the mortality is greater in females than in males, as it is also in advanced life. To make up, as it appears, for this generally increased mortality of the males, the simple, but as yet undiscovered, law of nature which controls the sex of the unborn child, so operates that about 106 boys to every 100 girls are brought into the world.

### **Cause of Sexual Peculiarities in Disease.**

The functions and structure of the generative organs and their appendages render certain diseases peculiar to each sex respectively. The number of these maladies is much greater in females than in males, on account of the far more important relation which the sexual organs bear to the entire feminine organism. They will be considered in a separate section in the latter part of this work. But many of the diseases which affect men and women indiscriminately are modified by sexual peculiarities of anatomical structure and functional activity. Thus, for example, inferiority in the digestive powers is obviously due to the facts that the mouth and teeth in the female are smaller, the jaws less arched, the stomach thinner and less capacious, the intestine supplied with less muscular tissue, the liver less bulky, and the bile therefore secreted in smaller amount. It is worthy of note also, that in the female the intestine is longer than in the male, thus approximating her more closely in structure to the herbivorous animals, which she also resembles in having less fully developed canine teeth. From these various causes it probably happens that females better endure hunger; and, indeed, it is a matter of common observation that, in prisons and hospitals, the consumption of food by women is one-fifth less than by men. Most of the noted fasts have been accomplished by women, and, either by the force of their wills, or as an effect of disturbance in their nervous system, we sometimes see them support a real abstinence from food for considerable periods of time. The muscular feebleness of the intestinal canal renders the female sex more subject to constipation and the manifold disorders which thereon depend. This tendency to constipation is further increased by the greater activity of absorption in the stomach and bowels, due to the more abundant supply of lymphatics in the female, causing the excrementitious matters to be harder and dryer. Hence the securing of a lighter, less abundant, and more laxative system of diet for the female is an important element in the hygiene of sex. Very marked differences are also met with in the functions of respiration, which likewise have their origin in anatomical peculiarities, and involve corresponding differences in the dis-



turbances which the lungs undergo when affected by disease. In consequence of the cavity enclosed by the ribs being narrower and more shallow, the lungs with their larynx and trachea are proportionately smaller in the female than in the male, and their play in the performance of respiration is more restricted. Consequently, a smaller quantity of oxygen is consumed and carbonic acid emitted by the female at each respiration. The blood of a female is richer in albumen and poorer in fibrin than is that of the male, and the whole blood-vessel system is more delicate and impressible, the pulse being less resistant, more frequent, variable, and easily accelerated. In accordance with these differences, we find the feminine heart smaller and softer and the arteries thinner and less firm. The secretion from the kidneys is less abundant in the female than in the male, and women are, therefore, less apt to suffer from disease of the kidneys and bladder than are members of the opposite sex.

For want of due attention to the avoidance of articles of food requiring strong digestive action, and the employment of such lighter aliments as milk, eggs, tender meat, and so forth, women are much more frequently sufferers from dyspepsia than men; whilst, on the other hand, organic diseases of the brain, doubtless because the lives of males are much more active intellectually, producing a greater amount of mental anxiety and excitement, are much more common among men than women. The diseases which are chiefly produced by inclement weather, or by hardship and, to the credit of the fair sex be it stated, those which are the results of bad habits, are more frequently met with among males than among females.

### **Heredity as a Modifying Influence of Disease.**

Very few physicians or physiologists of the present day would venture to deny the powerful effect of hereditary influence or heredity upon health and its disturbances. By this term heredity is meant to express the fact that a man inherits from his ancestors their personal peculiarities of constitution, temperament, and so forth, in the same way, but with far more certainty, than he inherits the houses and lands which constitute his external patrimony. It is to be particularly observed that each individual is especially moulded by the characteristics of his more recent progenitors; that is to say, although each person is wholly built up of his own and his ancestral peculiarities, a much larger proportion of these constituent elements are derived from his parents than from his grandparents, and so on backwards in a constantly decreasing ratio. Furthermore, personal peculiarities, however much they may differ in appearance from those which characterize immediate progenitors, are not by any means as independent as would at first sight be supposed by a superficial observer. On careful examination, these characteristics are often found to be modifications of attributes which have already existed either partly or wholly in

a latent condition in a man's forefathers. All the children of a family will, as a general rule, derive portions of their bodily and mental constitution from both parents, although some will bear a greater resemblance in stature, features, walk, gesture, color of the hair and of the eyes, to the father, and others to the mother. It is rare, however, to meet with any instance in which some distinctive characteristics which have been handed down from both parents cannot be traced. The influence of more remote progenitors on the bodily and intellectual constitution of the offspring is manifested by the resemblances which make up what is called Atavism, a term which is thus explained by Dr. Elam: A man does not inherit, for example, all the characteristics of either his father or his mother, and of those which are transmitted to him only some are developed, whilst others remain latent in him, although they may perhaps be developed in a brother or sister. His son may, however, inherit from him the same total of active and dormant peculiarities, but with this difference, that during the son's progress to maturity, some of those characteristics which have remained latent in the father through life, become fully developed in the child, so that he grows to bear a stronger resemblance to a grandparent, or some other relative, as an uncle or aunt, than to his father or mother. This inheritance of a quality which has apparently skipped a generation is called Atavism. The influence of race or special type in hereditary tendency is manifested by the regularity with which average height, weight, color of the eyes and hair, and so forth, remain the same, under tolerably constant conditions, from generation to generation, and this not only in regard to the whole body and its component parts, but also as respects the length of life, mental powers, and all the other circumstances, of social and individual existence. Deviations from these averages, which constitute the normal or natural type, although they are transmissible, cannot apparently exceed certain limits. For example, in relation to size, the giant and the dwarf form the extreme limits of the chain; and hence, in the offspring of individuals representing these deviations, a tendency to return to the standard of average development is frequently observable. As all forms of deterioration or disease may be regarded as deviations, that is, as already remarked, in the light of disturbed or perverted life processes, they are likewise subject to limitation in inheritance, and there is, happily for us, the same disposition manifested to return to the normal type, under improved external conditions. Thus, says Wilson, all chronic diseases appear to be transmissible, either as a morbid tendency, or in their general form; such diseased heritage being well exemplified in the cases of gout, scrofula, consumption, syphilis, or venereal disease, and insanity. But by adopting suitable measures the morbid tendency may frequently be eradicated from the family, or even the actual taint of disease overcome. It must also be remembered that any hereditary disease or morbid tendency may remain latent or dormant, like any of the



other characteristics mentioned, for one or a dozen generations, and then, by the process of Atavism, above explained, become developed in the next. Mental and moral qualities are subject to the same law of inheritance as the other personal characteristics, with this important addition, that any vicious habit or predisposition is very apt to become intensified in some form or other in the offspring.

The subject of hereditary tendency has usually been considered, even by many medical men, as relating to only a few diseases, and acting for short periods of time; but it may be so applied as to throw a flood of light upon medical science, and especially preventive medicine, by indicating to us all the most important dangers which threaten us from inherited diseases. This idea is an extension and practical application of the suggestion of Professor O. W. Holmes, who remarks, in one of his inimitable essays, that many people think that if they had but sent for the doctor early enough the patient might have been saved; and such a supposition is no doubt often true, only that "early enough" means, in many cases, fifty or a hundred years before the child was born.

If we expand this thought to the breadth and profundity of which it is worthy, we may realize that the life of each man and woman now living, or who has ever lived, upon our planet, forms a very small arc of an immensely great family curve, ascending through ages toward the survival of the fittest, or descending through successive generations toward that sad destiny which the author of this book was the first to formulate as the "extinction of the unfit."

In quoting above one of the watchwords of Darwinism and Evolution, any endorsement of these plausible yet visionary hypotheses, which would, if popularly accepted, prove ruinous to the best interests of humanity, and which ought therefore to be contested by every true philanthropist, as far as they are so arrogantly applied by some self-styled philosophers to an infinite and unknown past, is expressly disclaimed. Inasmuch, however, as events of our own era passing daily before our eyes are concerned, it is impossible to deny that the great law of the survival of the fittest, and its complement, the extinction of the unfit, are in constant operation. Who, for example, has not observed in a piece of woodland where chestnut trees have been cut down a few years previously, the thick growth of saplings which spring up around each stump of a large tree, and for a season or two develop with almost equal rapidity and vigor. At the end of the third year, however, the supply of sap from the parent root, as well as the supply of light and air, become perhaps insufficient for so large a family, and the struggle for existence begins in earnest. This struggle goes on until, at the end of ten or fifteen years, two or three of the young trees, having crowded out and starved out and shaded out all their near blood relations in the most unfraternal manner, alone remain as heirs and representatives of the paternal monarch of the forest. Of course,



some law must have controlled the decision as to which of the original fifty candidates for healthy and complete development should be permitted to attain the proportions of its ancestors; and since we must reject at once the supposition of blind chance being the ruling agency, our only alternative seems to be an acceptance, in this instance at least, of the law of the survival of the fittest. According to this Divine decree, the one of these fifty young shoots which is situated nearest the tap-root, supplying it with the richest and most abundant sap—provided it is the one best protected from cold, and most favorably exposed to air and sunshine; and provided, also, it is fortunate enough to best escape the attacks of insects and other enemies; briefly, in other words, the sapling which *internal vigor* and *external hygienic influences* conspire to render the fittest to survive—will be *the one* which does survive, at the expense of the very lives of its brethren, who perish in the merciless struggle for existence. The same laws may daily be seen actively operating in a litter of pigs, a herd of wild cattle, a swarm of fish, a flock of pigeons, and, indeed, throughout the whole of animated nature, except where the intelligence of man brings about certain partial and incomplete modifications of their sway.

Assuming, then, that the doctrines of evolution, as applied to minor variations occurring in our own times, contain some grains of truth, we must admit that mankind is no exception to their rules. And, indeed, this fully accords with the results of our every-day experience, which teach that whilst some families, nations, and races are improving and gaining ground in the struggle for life, others—such, for instance, as those in which the predisposition to consumption is very strong—are exemplifying before our very eyes the extinction of those comparatively unfit to survive. According to this conception of hereditary diseases as parts of the harmonious workings of this active, not merely passive, eliminating element in nature's grand law of progress, it is with the vast army of degenerating and degenerated human beings on the road to extinction that curative and preventive medicine has to deal; and, by making a practical and systematic use of our knowledge in regard to this tendency to the transmission of a diseased inheritance, nearly all the readers of this work can do much toward preventing the earliest seeds of disturbances to health from affecting themselves and their offspring.

Sanitary science affords many illustrations of how an acquaintance with this method, by which nature carries on her occult destructive operations, enables us to counteract these tendencies to death in that incipient and feeble state when a wise and close scrutiny, enlightened by information respecting the natural ordinances controlling inherited diseases, will often enable us to detect them. For example, children of a family in which there exists an inherited tendency to tuberculous maladies, such as consumption and scrofula, and who are, therefore, travelling the tuber-

cular highway to extinction, should be supplied with the most nourishing food, the purest air, and directed in the most carefully-regulated exercise, encouraged especially to expand their lungs and develop their chests, and jealously guarded from catarrhal attacks, which, when incurred, should be cured as speedily and thoroughly as possible; heirs of a race which is travelling the gouty or rheumatic road to destruction, ought to be subjected to suitable antidotes against the production of these disease-poisons, derived from the domains of both preventive and curative medicine; infants who struggle feebly along, in far greater numbers than most people are aware, upon the syphilitic downward path to death, need to have the abominable virus in their blood eradicated by the judicious administration of iodine and mercury; and so on, through the whole catalogue of inherited maladies.

As an illustration of the direct aid which this kind of study of inherited tendencies to departures from health may afford, it may be well to mention a circumstance which occurred in my own practice some years since. Upon this occasion I was called to see a little girl, six years old, who had been rather suddenly attacked with pain in the under side of the great toe, which was slightly reddened, and very sore to the touch. The account given was that she had been teasing her nurse by running about without shoes or stockings the night before, when, it was feared, that a needle had penetrated her foot. No puncture, however, was visible, and on further inquiry it appeared that her mother was a great sufferer, from acute or inflammatory rheumatism, experiencing her first attack at the age of eight years; that two of her maternal uncles had died of heart-disease, resulting from rheumatism; that one of her maternal aunts was sadly crippled with rheumatic gout, affecting the smaller joints; and that another aunt on the same side was a martyr to neuralgia. With such a history of inherited rheumatic tendency, little hesitation was felt in treating the case, which would otherwise have been a very puzzling one, as an attack of acute rheumatism—a course the correctness of which was fully justified the next day, when the ankles on each side became involved, and exhibited the characteristic swelling and pain of this distressing complaint.

The most efficient way for each reader to make a practical application of these natural laws of inherited diseases and predispositions to disease, would be for him to consult his (or her) family physician, and, revealing all the secrets of his own life and his ancestors' existence, assist the doctor by contributing every fact which could have a bearing upon the problem to be solved, namely, to determine the character and intensity of the diseased tendencies which have been inherited or acquired. No desire for secrecy, no false modesty, no pride in superior mental and physical organization, nor fear of the sickness and death which the future has in store, ought to be permitted to interfere for a moment with a most careful and



painstaking analysis of the family history and tendencies to disease in each person's particular case. And from such an investigation may be drawn up a most useful map or chart, infinitely valuable to each individual as indicating the especial rocks, currents, and quicksands to which he is individually exposed in his voyage through life. Not that people can be expected to live always in accordance with such a guide, and constantly obey the dictates of prudence, but only that they will, as a general rule, exercise self-denial in regard to the more dangerous temptations; and, when actually threatened with disease, adhere most strictly to their special rules of health, just as a mariner on a calm summer sea might neglect his monitor, but would watch his compass with an unsleeping eye and steer his ship most unswervingly in accordance with its monitions, when storms and tempests assailed the vessel.

Although these views will be more fully explained when treating of particular maladies in their appropriate places toward the latter part of this volume, some suggestions may be introduced here in regard to the management of certain important predispositions to disease, or *Diatheses* as they are called, which are frequently hereditary in their nature. Of these the most important is the Tubercular diathesis, which manifests itself in scrofula and consumption. This latter complaint, in temperate climates, such as that of our Middle States, kills about one-seventh of all the inhabitants, and therefore its prevention, since cure is generally impossible, is a matter of more interest than that of any other disease. The fatality of consumption, in families where the tendency exists in an intense degree, is something awful to contemplate, and probably few of those who consult these pages have not been called upon to mourn the loss of some dear friend or relative, cut off perhaps in the bloom of youth, by this merciless destroyer. Prof. Flint, of New York, relates that, in one instance coming under his observation, all the children of a family, seven in number, were victims of consumption in five years, their ages being between twenty-three and eighteen at the time of death. The mother died of the same malady shortly before the first of the seven children to whom it proved fatal, but the father was a man of robust health. A still more striking illustration, continues Prof. Flint, is afforded by the following history of a family, also met with in his own sphere of observation, comprising eight children: one died in childhood from convulsions, probably produced by tuberculous disease of the brain; three daughters and one son died of consumption; another daughter and a son were tuberculous at the time Dr. Flint wrote, and the only remaining child, the eldest daughter, presented the history and signs of arrested consumption. Both parents of this family died tuberculous. These records being vouched for by Prof. Flint, may be at once accepted as downright facts; and, admitting them to be such, what more conclusive evidence is needed that hereditary degeneracy does actually, before our



very eyes, according to a law of nature, accomplish the extinction of families which are physically unfit to live. Turning from this sad picture of early decay, we may find some consolation in the lesson which it teaches, especially when we consider that probably in one-half of the patients who die of consumption, it is the combination of the common and avoidable causes, such as cold and dampness, with the predisposing one of hereditary tendency, which results in an onset of the fatal malady. Hence, at least fifty per cent. of all the deaths from consumption are preventable by due care and hygienic treatment, such as will be pointed out later in this work, in protecting the subjects of hereditary tuberculous tendency, and so securing the dormancy through life of this otherwise fatal predisposition toward pulmonary disease.

### **How to Combat Nature's Law of Extinction.**

In attempting to make a direct and practical application of our knowledge respecting inherited predispositions to disease, and counteract as far as possible Nature's law of "the extinction of the unfit," let it be supposed for a moment that a parent who has lost one or two children in early life, being exceedingly anxious to give his other infants every chance to grow up healthy men and women, wishes to order the sanitary arrangements of his household to the best possible advantage. The first thing to do, of course, is to find out in what particular way Nature is endeavoring to extinguish this unfit family, and to gain such information the family records must be examined with the most scrupulous care. On exhaustive inquiry we will imagine it is found that, although the father and mother are apparently in good health, an uncle on the father's side was lame from about his tenth year in consequence of hip-disease, and that a sister of the mother had imperfect sight, from her eyes being affected with scrofulous ophthalmia in infancy, also that the maternal grandmother had died comparatively young with symptoms of some pulmonary complaint. These facts soon lead to the suspicion that this particular family is travelling slowly but surely in what has been called above the tuberculous highway to extinction; and such suspicions become almost certainties when we learn that, whilst one of the lost infants was cut off by some accidental disease, such as croup, the other died from tuberculous meningitis, or dropsy of the brain. The first question, as to the dangerous hereditary tendency of this family, which happily, as yet, lies dormant in the bodies of the remaining infants, being thus answered, a next duty is to determine how this destructive effort of nature can best be counteracted, and the children rendered more fitted to survive in the struggle for existence. It is manifest at the outset that this second problem has, as it were, two branches to its solution, corresponding to the two factors which enter into it. That is to say, we may, on the one hand, so modify the surroundings or environment of the children that, without any change

in their own bodies, they become, relatively to their altered circumstances, more fit to live; and in the second place, by the most judicious employment of food, exercise, and medicines, the constitutions of these children may be so altered that even if circumstances were to remain the same, the infants themselves would become less under the control of their constantly acting tendency to tubercular disease. Common sense dictates, of course, that these two methods should be combined, in endeavoring to frustrate the destructive efforts of Nature; and therefore we would, on the one hand—as it is well known that confinement to the house, seclusion from the light and from fresh pure air, and deficiency either in quality or quantity of food, promote the development of consumption and scrofula—urge removal to the country for at least six months in the spring, summer, and autumn, and a bountiful supply of wholesome, nourishing food, with occasional visits to the sea-side, where the salt air and bathing are probably very important anti-tuberculous remedies. To serve the other purpose, that of modifying the environment in such a way as to favorably influence the chances of life, something can be done by securing light, airy, well-ventilated apartments for nurseries, even in city houses; but the true remedy in this direction is a winter residence in Aiken, in Florida, the Bahamas, or in Cuba, because it is well known that, in these regions, cases of tubercular disease among the native population rarely occur. That the efficacy of winter residence in a southern climate in cases of this kind is not a mere matter of opinion, but a downright fact, is shown in multitudes of instances, and particularly in that shining light of the medical profession, Dr. J. H. Bennett, who twenty-five years ago was sent to Italy, given up to die with consumption by the best London physicians, and yet, by an annual autumnal migration to a southern climate, has regained a fair state of health and prolonged his life for more than a score of years. Lastly, the parents of these children, whose chance of life we are supposed to be so anxious to improve, should especially guard them against the exciting causes tending to aid the predisposing ones in the extinction of their only moderately unfit organisms, which might otherwise escape premature death. To do this successfully, the parents of these infants must constantly bear in mind what are the particular directions in which the tubercular diathesis manifests itself at different periods of life, namely, that from two to seven years of age, the chief tendency is to dropsy of the brain and to scrofulous sore eyes; between six and fifteen, to hip-disease, disease of the spine, and of the smaller joints, and the glands; whilst from fifteen to twenty-five or thirty years, to the development of consumption. Hence it is very important that children of all such families as this should not be encouraged, or even allowed, to exercise their brains and their eyes in study, except as a mere amusement, until after they attain the age of eight years, and that during the same period falls or blows on the head, and exposure to the



direct rays of the sun, should be scrupulously avoided. After the age of six, until the fifteenth year is attained, strenuous efforts should be made to guard against falls, bruises, and strains of the hips and back, which often appear to be exciting causes of scrofulous affections in those portions of the body. Subsequent to the fifteenth year our chief care ought to be directed towards protecting the lungs, now by far the most vulnerable organs, from the exciting cause of cold, as operating through the injurious conditions of having wet feet, sitting in damp clothes, being exposed to a draught of air whilst perspiring or during sleep, and so forth. In this, and similar ways, there is no doubt that the warning suggested by my formula of the "extinction of the unfit" may be beneficially applied to multitudes of cases met with on every side in our northern cities, where so often are encountered families in which a stronger or feebler tendency to tuberculous disorders exists. But the application of this great principle does not stop here, for under the same general rules may be readily comprehended, and to some extent counteracted, hereditary predispositions to gout, rheumatism, neuralgia, syphilis and, indeed, the whole class of constitutional maladies.

A recent English author reports such a remarkable instance of the value of hygienic management in that insidious malady, Bright's disease, when hereditary in a family, that it may be here condensed for the information of persons interested.

A lady, aged sixty-one, of a family of most temperate habits, died in 1860 of Bright's disease, and one of her children died of the same complaint in 1872, at the age of thirty-four. Another child died in 1873, aged thirty; and still another in 1880, aged forty-six—all of the same affection of the kidneys. In one of these cases the disease was known to have existed for ten years, and in another all its signs were manifested for seventeen years before death. Another child had the complaint for twelve years, and of her children, grandchildren of case No. 1, two out of five have Bright's disease—one for the past ten years, and the other for the past nine years. In all these cases great attention has been paid to hygiene, and its influence has been most marked and favorable. Several times grave symptoms of poisoning of the brain by the unpurified blood would appear, but under hygienic treatment would pass off again without a fatal result. Patient No. 4, above referred to, who died at forty-six, and who had the disease for seventeen years, afforded the most striking proofs of the value of sanitary care in this complaint. During nearly all the time his urine contained a good deal of albumen, and showed besides the usual microscopical evidence of the presence of Bright's disease in a marked degree. He led an active business life, but endeavored to take systematic care of his health, wearing Shetland wool under-clothing, keeping up out-door exercise, and leaving work now and then for long holidays. He was more careful than his brothers, and



lived longer with the disease than they did. He often wintered in the south of Europe, but in an evil hour was persuaded to take a voyage to Alexandria in March, contracted dysentery there, and almost lost his life in consequence. Subsequently, returning from the south of France, he crossed the Alps sitting on the outside seat of a carriage, and as a result of this imprudence caught cold; dropsy of the chest set in, and he died on the homeward journey. The whole experience of this afflicted family goes to prove that hygiene has infinitely more power in prolonging life than has any known drug in curing Bright's disease of the kidneys.

### Various Other Hereditary Predispositions.

As further guides toward enabling persons to determine what other hereditary tendencies exist in their constitutions, or those of their families, may be enumerated a few of the characteristics which indicate the gouty and the scrofulous diatheses respectively. Persons of the gouty diathesis, or predisposition, are usually well-made and often corpulent. The bony structures are well-developed, the muscles full and firm, the skin clear, the complexion ruddy, the teeth massive, regular, and free from decay. The hair is either fine and falls from the crown of the head early, or it is thick and coarse, in which case it is much more apt to remain, but becomes gray or white. The respiration and circulation are active, the mental powers vigorous and enduring, the courage high, and the temper somewhat hasty. From its combination of bodily and mental characteristics, people of this type are usually enterprising and energetic, endowed with a capacity for great endurance, and capable of much and sustained labor. Their great danger is their temptation to live too well, arising in part from their vigorous digestive powers, and thus developing the inherited tendency to disease. Some of my readers may have heard the story of the young man who was a martyr to gout, and who, on being consoled with by friends, over what seemed to be undeserved sufferings, exclaimed, "Ah, that is just it; I don't mind the pain so much, though that is bad enough sometimes; but what enrages me is to think, as I writhe in agony, that I have never had any share in the feasting and the pleasure my ancestors enjoyed, whilst they were getting this accursed disease, which I have to suffer from, into our family." This anecdote contains a most important lesson to all students of preventive medicine, and the argument it supplies against over-indulgence of the appetites may serve to check the excesses of well-intentioned men, who may be induced, through parental affection, when the consequences are duly pointed out to them, to abstain from pleasure for which their innocent, unborn children must pay such cruel and undeserved penalties. Not only gout and rheumatism, but the gouty form of Bright's disease, affections of the heart and blood-vessels, and recurring inflammations of an arthritic or gouty character, are dangers to which people of this diathesis are liable. But

notwithstanding all, they are apt to live to a good age, rarely dying before the period of decline.

Very different are the characteristics of the strumous diathesis. Persons thus unfortunately endowed are deficient in vital force, the circulation being weak, the skeleton neither so well developed nor so well proportioned, the muscles rather small and soft, the joints large, the teeth irregular or soon affected with decay. The hair is fine and thin, the eyebrows well marked, and either unusually straight or very much arched; the eyelashes long; the lips full, as are also the nostrils. The mind is quick, often bright, but superficial, and there is a great liability to precocity in children of this diathesis, though they are particularly apt to die in early life. Indeed, the mental activity which precedes or accompanies the early stage of consumption, seems sometimes to be almost characteristic. But it is questionable how long brilliancy of intellect would have been retained, even if the body had continued in its usual health.

Conditions surrounding conception often have very great influence in implanting hereditary tendencies upon the offspring. Thus, for example, it was observed in France that children whose existence dated from the first French Revolution and its awful Reign of Terror, were nervous, irritable in mind, and liable to become insane from comparatively slight exciting causes. One of the most distinguished authorities upon idiocy lays it down as a rule, that of idiots the largest proportion are first-born children, the imperfection here representing or reflecting the disturbances of the mother's nervous system about the time of her first conception. The next largest list consists of the youngest children, the idiocy here indicating the degenerative changes of the period of decline in the father.

The effects of inherited tendencies to syphilitic disease upon the second and even the third generation, will be described under their appropriate heads.

The victims of an inherited appetite for alcohol are far more numerous amongst us than is generally supposed, simply because, in almost every instance, the unfortunate heir of this vice tries to baffle all inquiries which would stamp the brand of drunkenness upon either of his parents. Darwin declares that it is remarkable that all the human diseases arising from indulgence in spirituous or fermented liquors are liable to become hereditary, even to the third generation, gradually increasing, if the cause be continuous, until the family becomes extinct. There are nations or large communities with whom this fearful tendency to drink is an inheritance, to the utter perversion of their own character. The average condition of each generation in a family of hereditary drunkards, would be represented by a downward sliding scale commencing with simple indulgence in intoxicating liquors, and descending through the stages of frequent attacks of mania-a-potu, and insanity or imbecility, along the road to the extinction of the unfit, until the race is blotted from existence.



During the interval between the first and last generation, the successive inheritors of this terrible disease are divided up between the lunatic and inebriate asylums, the prisons, and the outside world. Some few manage to hold a position in business, or even in professional life; but all require constant care to prevent them from becoming lunatics, imbeciles, or homicides.

### **Habit as Modifying Disease.**

The curious memory of the body, which prompts us to repeat any action which we have several times performed under certain circumstances, whenever those conditions recur, is called habit, and has a very real influence in modifying disease. This disposition to repetition is well illustrated in the feeling of hunger, felt strongly at a certain hour of the day, when we have been accustomed to gratify it; and the same kind of periodical longing is experienced for alcohol, tobacco, or opium, when a habit of indulgence in these disturbing agents has once unfortunately been acquired. The disposition to evacuate the bowels, the desire for sleep, and the tendency to awake at a certain hour, are all very much under the control of habit. The manners and customs of nations are mainly the result of habits continued through a long succession of generations; and, just because these are the growth of centuries, it is more difficult to change them, in many instances, than it is to change a long-established habit in an individual. Some nations, like some persons, are more under the influence of habits than others, acquiring them with more facility and losing them with less readiness. It would, of course, be impossible to discuss at length in a work like this all the disturbances to health arising in unwise habits prevalent in the community. There are, however, three or four of these, the effects of which are so widespread, and at the same time so far from being recognized in their appalling proportions, and their power for injury is so constantly exercised to hurry on the rapid extinction of the unfit, that it becomes a duty to warn readers against them with all possible earnestness; and also to urge every one who can in this way be reached, to diligently do his share to check these evil tendencies, which, whilst partly at least the result of civilization, now actually threaten to bring destruction upon the civilized portion of our race.

The habits to which reference is here made are intemperance, immorality, criminal abortion, and masturbation, all of which have such tremendous effects upon the health and very existence of individuals, families, and nations, that they demand of every true student of sanitary science a far more careful investigation than it would be proper to give them in this place. It is proposed, however, to consider them incidentally, at some length, in the chapters on alcoholism, venereal disease, and the diseases peculiar to women.



# PART I.—PREVENTIVE MEDICINE.

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## CHAPTER I.

### WATER IN ITS HYGIENIC RELATIONS.

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#### **The Uses of Water.**

FEW people who enjoy the benefits of water think what a wonderful and unanswerable argument is afforded by them in favor of the goodness of an all-wise Creator to his creature, man. Of all the fluids with which we are acquainted, water is by far the best adapted to the almost infinite variety of human wants, and it is the one of all others most abundant in nature, constituting as it does about three-fifths of the surface of our globe, and nearly seven-tenths of the bodies of man and of most animals. If the common fluid upon which we had to depend were quicksilver, or oil, its boiling-point would be so high that articles of food which we attempted to cook in it would be seriously injured in the effort to prepare them by its aid; and, on the other hand, nearly all the advantages of ice would fail us, in consequence of the exceedingly low temperature at which these substances remain fluid.

Water was considered by the ancient philosophers as one of the four elements out of which all visible objects were constructed; and, in reality, it enters to a greater or less extent into the composition of nearly all natural substances. Thus, for example, some vegetables, like cabbage or celery, contain as much as ninety-five per cent. of water; and, on the other hand, close-grained marble may contain as much as four per cent. of water, or almost a quart to the cubic yard. On account of its remarkable solvent powers, which enable it to take up a smaller or larger quantity of nearly every substance with which it comes in contact, water is never found pure in a natural state; and, indeed, absolutely pure water for chemical purposes can only be obtained by repeated careful distillations. A considerable amount of air generally exists in water, and is

taken up by the gills of fishes, assisting them to accomplish the proper aeration, or rather oxygenation, of their blood. The air usually mingled with water may be expelled by boiling, but is absorbed again if the boiled water is agitated with access of the atmosphere. The insipid taste of water which has been boiled is due to the absence of air. Many gases besides air may be artificially or naturally mingled with water, and some, like ammonia or nitric acid, are freely soluble in it. In sea-water, the presence of common salt, with small quantities of sulphate of soda or Glauber's salt, and of the compound of magnesia and chlorine, called chloride of magnesium, render it entirely unfit for drinking, as many a hapless shipwrecked sailor has found to his cost. At the present day, most sea-going vessels are provided with apparatus for distilling the water of the ocean, and so producing a pure and wholesome but insipid water, which can be rendered, however, more palatable by agitation with plenty of fresh air. Hence, the horrible agony of death by thirst among sailors is now much less frequent than formerly, although mariners in open boats, or cast upon small uninhabited islands, still sometimes scan with anxious eyes the briny waste around them, beholding—

“ Water, water everywhere, but not a drop to drink.”

Sea-water varies considerably in composition, being of course more concentrated, as a rule, in the tropical regions, where evaporation is most active, such, for example, as in the Mediterranean Sea and the Atlantic Ocean near the equator. According to analysis, the water in the English Channel contains in 1000 parts—

|                                   |       |
|-----------------------------------|-------|
| Chloride of Sodium, . . . . .     | 28.05 |
| Chloride of Magnesium, . . . . .  | 3.66  |
| Sulphate of Magnesia, . . . . .   | 2.29  |
| Sulphate of Lime, . . . . .       | 1.40  |
| Other Saline Materials, . . . . . | .76   |
| <hr/>                             |       |
| Total Solid Matter, . . . . .     | 36.16 |

Besides these, and perhaps contributing largely to the healthful qualities of sea-water, there exist in the ocean small quantities of iodine and bromine, and extremely minute amounts of some of the common metals. It has been found that, by dissolving a little common salt and carbonate of soda, lime, and magnesia in distilled sea-water, its taste is rendered much more agreeable; and this plan, it is said, is adopted in the Russian navy.

The temperature of the water of the ocean is much less easily influenced by the heat of the sun's rays than the air which floats above it. Thus, for example, between the tropics, where the summer-air temperature may attain a height of 130° or 140° in the noonday sun, the temperature of the ocean rarely rises above 80° Fahrenheit. At a distance from

the coast, in temperate climates, the temperature of the sea does not vary more than about  $20^{\circ}$ —being about  $50^{\circ}$  in winter and  $70^{\circ}$  in summer. This equability of the ocean temperature has a very important modifying effect upon the climate of maritime countries, rendering them cooler in summer and warmer in winter—thus often favorably influencing the health of the inhabitants. In some islands, as for instance in Madeira and others of these little islands, the thermometer has not, it is said, fallen below  $60^{\circ}$ , or ascended above  $80^{\circ}$ , from one year's end to another. The water, which rises in vapor into the atmosphere from all the oceans, seas, lakes, and rivers of the globe, is condensed after a longer or shorter time, and falls to the earth again as rain. Rain-water, being in reality a distilled fluid, is the nearest approach to a pure water which we find in nature, and when caught in clean vessels placed upon elevated objects, is almost free from contamination. It contains, however, small quantities of organic matter, nitric acid, and ammonia, all of which are washed out of the air through which it descends as rain. The source of the nitric acid is believed to be the nitrogen of the atmosphere, which combines with oxygen under the influence of the electric spark during thunderstorms. Nitric acid in rain-water exists in such insignificant amount as to be entirely unimportant in itself; but it adds very seriously to the danger of impregnation with lead from lead pipes, roofs, and cisterns, by rapidly dissolving that metal and forming the very soluble and highly poisonous salt, nitrate of lead.

### Sources of Drinking Water.

Our supplies of drinking water are, of course, derived originally entirely from the rainfall. We need not consider now how the water found its way into the air. Without entering into the details of the process of evaporation, all that the present object requires is, that we clearly recognize the fact that spring, fountain, river, and lake are all alike fed from the clouds which float over our heads and send their rain upon the just and upon the unjust. Hence, then, man is wholly dependent for his supply of this vital element upon the rain which comes down from heaven. He may dwell upon the most arid plains, but he drinks from the stream which flows beside or underneath his feet—which stream is itself fed by floods that fell perhaps a thousand miles away—and whatever mystery attaches to subterranean waters, we may be sure that, by a long enough circuit, we can trace every drop back to the clouds. The rain which falls upon the face of the earth meets with various fortunes. A part of it—the storm-water, which furnishes most of our drinking fluid—washes the surface of the ground, carries away from it in suspension many of its finely-divided particles, dissolves what it finds easily soluble along its path, is gathered into open drainage channels and, forming part of some river system, hastens to the sea. It touches geological problems at every



inch of its way—some of which will be referred to briefly when speaking of soil and climate in their relations to human health.

### Varieties of Water.

In classifying waters, we have first to consider them as regards their sources. Rain-water, as already mentioned, is sweet and soft, and when filtered is perfectly adapted to all the purposes of life; the one difficulty about its use being the impossibility of collecting it pure, and preserving it without contamination for the long periods of time and in the large quantities which would often be necessary. Spring- and well-waters are almost always more or less impregnated with the soluble ingredients of the earth and rocks through which they pass, and are therefore sometimes very unsuitable for the ordinary wants of life. As a general rule, they are colder than other waters, although hot springs are found in various parts of the world, some with a temperature as high as the boiling-point. Mineral springs, notwithstanding they are much used for drinking, are properly medicinal agents. They comprise all those waters which contain sufficient quantities of dissolved matters, such for example as iron or sulphur, as to produce thereby a positive effect upon the systems of persons partaking of them. The mineral springs of this country are frequently valuable remedial agents in some chronic diseases. River-water is, to a certain extent, similar to spring-water, but is much more apt to be contaminated with sand and clay, organic material from decomposing vegetable or animal remains, the refuse of manufactories, and especially with the sewerage of cities and towns, to which it is probable immense amounts of sickness and death are annually due in all civilized countries. Unfortunately, river-water is that which is chiefly supplied to towns and cities, and therefore finds its way into the systems of vast numbers of our fellow-beings. Stagnant water is, from the large quantity of organic matter in a decomposing state which it holds in suspension or solution, exceedingly unfitted for drinking and culinary purposes, no matter how transparent it may appear; and it should, in consequence, be carefully avoided whenever running water can possibly be procured. Pond-water, canal-water, ditch-water, and marsh-water all come under this category, and should be scrupulously shunned, under penalty of suffering from fever and ague, dysentery, typhoid fever, and many other dangerous maladies.

Some authors upon hygiene further arrange the different kinds of water into three groups, according to the various uses to which they are applied. The first of these comprises the drinking waters, including the mineral waters, which, though medicinal, are chiefly so by being taken into the stomach; second, the washing waters; and third, the bathing waters, under which head the waters of the ocean are entitled, from a sanitary point of view, to a prominent place. A very important consideration in

regard to water-supply, whether it be for a single family or for a large community is, next after its purity, its abundance. Many instances are on record where, after comparatively expensive water-works had been constructed, it was found that the amount of water obtained was insufficient, and new arrangements must be made. The quantity of water needed by man and animals must therefore be very carefully calculated. Repeated experiments upon a very extended scale in England have shown that a healthy man requires daily as drink from two to four pints of water, this amount being in addition to that which is swallowed as moisture in food. The amount required for cooking is estimated at from half a gallon to a gallon or more. To this quantity, Dr. Parkes considers, should be added for daily ablution, including a sponge bath, five gallons; daily share of kitchen and other utensils, and house washing, three gallons; and share of clothes washing, another three gallons; making up a total of a little over twelve gallons for each individual daily. In the poorer districts of the city of London, the amount used is stated to be only about five gallons daily. A shower-bath will require about four gallons extra, and a plunge-bath from forty to sixty gallons. Where water-closets are used, an additional quantity, of from four to six gallons daily for each person, must be provided. Prof. Rankine estimates that the average daily allowance for each individual in large towns should be ten gallons for domestic purposes, such as those already enumerated; ten gallons for municipal purposes, such as washing streets, extinguishing fires, and so forth; and ten gallons more for trade purposes, at least in manufacturing communities. This total of thirty gallons per head, large as it may seem at first sight, is actually furnished to many towns at the present time. Thus, for example, the amount furnished daily to each individual in Paris is thirty-one gallons, and the different London water companies supply from twenty-one to thirty-four gallons daily per head to the entire population. In American cities the item of waste enters largely into the account, so that much greater quantities are theoretically furnished. For instance, in Washington 138 gallons, and in New York about 100 gallons, are supplied daily for each inhabitant. In large towns and cities, especially with the combustible buildings so common in the United States, the source of supply must be capable of furnishing a quantity, in case of extensive fires, vastly in excess of the average consumption. In the great fire of Boston, in 1872, when about sixty acres in the business portion of the city was involved in the burned district, whilst the daily consumption of water was a little over 12,000,000 of gallons, nearly 17,000,000 of gallons are thought to have been used. The amount of waste is so great that, according to the report of the Chicago public works, one-half of the water pumped is wasted, and the cost to the city of wasted water in St. Louis was estimated at \$4,000,000 in ten years. In some cases an attempt has been made to diminish the necessity for a very large amount of pure water, by



having two sets of pipes, and introducing two kinds of water, one pure enough for drinking and culinary purposes, and the other suited to the less delicate uses, such as most of the municipal and trade purposes. But, in addition to the seriously increased expense of such a double system, it is found in practice that the purer water is generally employed for nearly all purposes, and little saving is therefore accomplished.

In England, and on the continent of Europe, there are many places where the water-supply is only let into the distributing pipes of a certain section of a town, for example, during a few hours each day, and then turned off and transmitted to another part for another short period. This is called the intermittent supply system; but it has so many disadvantages, prominent among which is the entrance of foul air and organic matters into the empty pipes, whilst they are not in use for delivering the water, that it has seldom been adopted in this country, and is stated to have fallen into disfavor abroad.

### **Diseases from Mineral Impurities in Water.**

Since all river-, spring-, and well-waters contain a certain amount of dissolved matters, taken up from the soil through and over which they pass, it becomes a very important consideration to determine what these ingredients are in any particular sample of water, and also the kind and degree of such impurity which will not prove injurious to health. Dr. Letheby, from investigations made in sixty-five English and Scotch towns, arrived at the conclusion that from five to twenty grains to the gallon of the compounds of lime and magnesia are necessary to render drinking water in the highest degree wholesome. But any quantity of saline impurity exceeding thirty-five grains to the gallon, renders a water unfitted for the freest domestic use. Such water would be popularly designated as a very "hard" water, but a good deal of difference is caused by the nature of the hardness, that due to sulphate of lime, and called the permanent hardness because it is not removable by boiling, being decidedly most prejudicial to health. The symptoms referable to an excess of alkalinity, arising from the presence of these earthy salts in a drinking water, are mainly those of a dyspeptic nature. At first the employment of hard water, by persons who are unaccustomed to it, produces diarrhœa, which is occasionally serious or even dangerous in its character. But the long-continued use of such a drinking fluid is thought to cause habitual constipation, with the heavy train of evils, including piles and liver complaint, which depend upon it. Calculus, or stone in the kidney or in the bladder, which gives rise sometimes to the most horrible agony human beings are ever called upon to endure, is believed to be due, in many instances, to an excess of lime and magnesian salts in the drinking water. The swelling of the thyroid gland in the neck, producing the repulsive deformity of goitre, or Derbyshire neck, seems to be intimately connected with



mineral impurities in water. In Nottingham, England, where this disease is not unfrequently met with, the common people attribute it to the hardness of the water; and in other parts of Great Britain it is found to prevail only, or at least especially, in those districts where the magnesian limestone formation abounds. Dr. Coindet, of Geneva, Switzerland, asserts that Goitre is speedily produced in persons who drink the hard pump-water in the lower part of that town, whilst in other parts of Switzerland the use of spring-water has been followed by the development or augmentation of goitre in a very few days. In India also it has been shown conclusively to prevail, to any marked extent, only where the magnesian limestone rocks underlie the soil; but whether it is the lime and magnesian salts, or whether, as has been suggested, it is the presence of sulphide of iron in the bed-rock formation, which is the direct cause of the development of Goitre, has not yet been positively determined. It appears certain, however, that Goitre is originated by some water impurity, and that this contamination is of an inorganic and not of an animal or vegetable nature.

A small quantity of organic matter of vegetable origin, that is to say, an amount not exceeding three grains to the gallon, is not generally found to be injurious; but even very minute quantities of organic material *of animal origin*, especially if this material is composed of the waste matters, such as urine or excrement, from man or animals, is the great cause of unwholesomeness of water. Probably one-fourth of the sickness and death in civilized communities arises directly or indirectly from this one cause; and, unfortunately, even when we are fully forewarned of this imminent danger to health, it is exceedingly difficult, in most thickly populated places, to secure a source of water-supply with which sewage has not been mingled.

The earthy and organic matters which are so abundant in the river-waters of many of our Western States, almost invariably produce diarrhœa in those who are unaccustomed to their use; though this complaint gradually ceases to manifest itself in most cases if the drinking of such water is persisted in. The water of the Mississippi, the Missouri, the Kansas, and the Rio Grande has frequently been found to give rise to severe diarrhœa, continuing for several weeks, and occasionally terminating in ulceration of the bowels and death. Even in persons who can under ordinary circumstances drink the waters of these rivers with impunity, frequent intestinal discharges are produced when floods, such as has recently been experienced in Cincinnati, have caused an unusually increased amount of earthy and organic matter to be carried along in suspension, from the head waters of the tributary streams, and from the overflowed banks.

The effects of minute traces of metallic substances in drinking water have not yet been ascertained with sufficient accuracy, but it is quite possible that the entire sanitary condition of a district may depend in some meas-

ure upon impurities of this description. Mr. Wanklyn suggests that the well-known salutary effect of what is called change of air may be, in reality, partly due to the escape from some extremely small metallic impurity in the water of the section of country from which removal takes place; and it has long seemed probable that the increasing prevalence of that terribly fatal malady, "Bright's disease," especially in cities and large towns, may be due to the poisonous effects of exceedingly minute quantities of lead, dissolved from the lead pipes so generally employed as service-conduits, notwithstanding the protective coating which usually forms so promptly upon them.

The poisonous effects of larger amounts of metallic impurity, by which is meant quantities sufficient to be easily detected by chemical reagents, have been very extensively studied; and a knowledge of the dangers to which health is thus exposed, and the methods of detecting and avoiding them, is very important.

### Poisonous Effects of Lead in Drinking Water.

These are probably very common throughout our whole country, and, contrary to what at first sight might be imagined, it is likely that lead much more frequently and seriously affects the health of people inhabiting small villages and country houses, than that of residents in cities, notwithstanding the latter constantly use water which is brought into their houses through long lines of lead service-pipes. The explanation of this seeming paradox is that river-water, which is that usually supplied to citizens, contains in almost all cases a small amount of the sulphate of lime, sulphate of magnesia, or some other compound of sulphuric acid, which, when brought in contact with the lead pipes, is decomposed, and the resulting sulphate of lead which is formed has the happy faculty of clinging to the inside of the pipes where it is produced, and thus constituting an insoluble lining, which not only protects the tube from further corrosion, but also, what is of far greater importance from a sanitary point of view, prevents any further contamination of the drinking water which flows through the conduit. In rural districts, on the other hand, wherever rain-water is used for drinking purposes, it is exceedingly liable to be contaminated with lead from lead-lined cisterns, lead service- or collection-pipes, lead roofs, or from the solder of tin roofs. As a rule, the purer the rain-water, the greater is its action on lead with which it stands in contact; hence, therefore, the presence of a minute quantity of some salt of sulphuric acid in water is of a very great importance, and serves as an invaluable protection against lead-poisoning to the human beings and animals who may employ it for drinking purposes. When pure water recently boiled is placed in, or run over, lead, no action takes place; but if the water, after being boiled, is exposed for a short time to the air, from which it absorbs oxygen and carbonic acid, and is



then brought in contact with lead, we soon find that a whitish film, which on chemical examination is found to be composed of the carbonate of lead, is formed upon the metallic surface. This whitish film, which easily separates from the lead on which it appears, and becomes mechanically mixed with the water, is very poisonous. Since, as already mentioned, rain-water contains usually some nitric acid, in addition to the oxygen and carbonic acid which it absorbs from the air, and this nitric acid combines with lead to form a very soluble and poisonous nitrate of lead, it is much more dangerous than even pure aerated water, after standing for a short time in contact with a leaden surface.

Rain-water intended for drinking or cooking purposes ought therefore never to be collected from lead or tin roofs, transmitted through lead pipes, nor under any circumstances stored in lead-lined cisterns of any kind.

Dr. Hammond, of New York, instituted some very instructive experiments, some years ago, with reference to the action of water upon lead. Thus, on one occasion, he took some fresh rain-water collected in a wooden vessel, and placed it in a bright leaden jar. Upon testing a portion of it, only twenty minutes afterward, by passing through it a current of sulphuretted hydrogen gas, a brown precipitate of sulphide of lead made its appearance, proving that even in that short space of time a perceptible quantity of the metal had been corroded and dissolved. One pint of this water, after it had stood in contact with the surface of the lead for six hours, was found on analysis to contain one-seventh of a grain of lead. This amount was quite sufficient to have caused dangerous lead-poisoning in almost any person who used the water in which it existed as a drink for even a few weeks. In order to determine how small an addition of a sulphuric-acid salt would be sufficient to prevent such contamination by lead, another portion of rain-water, in which, for the sake of the experiment, five grains of sulphate of magnesia to the gallon had been dissolved, was next placed in the leaden vessel. No taste was communicated to the water by the introduction into it of this amount of Epsom salt. Upon testing it as before at the end of half an hour, not the slightest precipitate was produced by the sulphuretted hydrogen, showing that none of the lead had been taken up; but a white coating had already commenced to form upon the surface of the metal. The water, as thus protected by the sulphate of magnesia which had been dissolved in it, was retained in contact with the lead of the jar for thirty days without becoming in the least contaminated by that poisonous metal.

Many other experiments were made, the general result of which was to show that the purer the water, the more danger there was of its dissolving any lead with which it was allowed to come in contact.

The quantity of lead necessary to produce injurious effects, if the water which contains it is used as a drink, is very small, and probably differs



a good deal for different persons, some individuals being much more susceptible to the evil influence of lead than others—this varying degree of susceptibility to disease-poisons of various kinds being extremely common. In the celebrated case of the accidental poisoning of the ex-royal family of France, at Claremont, by lead which was taken up in the drinking water, the amount was found not to exceed one grain of the metal to the gallon of water. From cases which have since been observed, it would appear that the habitual use of water containing one-tenth or even one-twentieth of a grain per gallon, is sometimes attended with danger. In his investigation into the cause of that curious disease, as it was formerly considered, the Devonshire colic, Sir George Baker, who discovered that it was only a form of lead-poisoning due to the drinking of cider fermented in lead-lined vats and troughs, found that eighteen bottles of cider he examined contained four and a half grains of lead, or a quarter of a grain to each bottle. Under some special circumstances, not at present well understood, extremely minute amounts of lead in water may prove injurious. Thus, for example, Dr. Angus Smith speaks of cases in which lead-paralysis, or palsy, was apparently produced by water containing only one one-hundredth of a grain of lead to the gallon.

The method of detecting the probable presence of lead in a sample of drinking water is so simple, that every reader is advised to take the first opportunity of examining their own water-supplies, and so making sure that they or their families are not liable to the insidious dangers of lead-poisoning. In order to determine whether a water is contaminated with lead, all one has to do is to drop two or three drops of the solution of sulphide of ammonium into the suspected fluid, contained in a white bowl or large cup, and observe whether a brownish or yellowish coloration is produced. If the liquid remains perfectly clear and colorless, you may be sure that it either contains no lead, or that such a metallic impurity is present in a quantity of less than one-tenth of a grain to the gallon, an amount which is not generally injurious to health. If, however, a slight brownish tint is produced in the water which is being tested, it must not be too hastily condemned as poisonous, since either copper or iron might give rise to the same coloration with the reagent. Such a suspicious water ought, however, to be promptly analyzed by some good analytical chemist before being employed for either cooking or drinking purposes any further. The sulphide of ammonium may be purchased at a small cost, say for twenty-five cents an ounce, of most dealers in chemicals; and, as its odor is extremely disagreeable, it should be kept carefully corked until the moment it is used. The experiment should be made upon about half a pint of the suspected water; and, if the contamination is supposed to be caused by lead pipes, it is a good plan to test a portion of the liquid which has stood over night in the conduits. The mode of discriminating the precipitate caused by iron from those due to the dangerous metals, lead

and copper, is to let fall a few drops of hydrochloric acid, called also muriatic acid, into the fluid. If the brownish or yellowish-brown tint disappears, we may know that innocent iron is the only metallic impurity; whilst if, on the contrary, no change is effected by the addition of the acid, one of the poisonous metals, lead or copper, is present. No water, however, in which the slightest tinge is produced by adding the sulphide of ammonium, should be swallowed by man or beast until a rigid investigation by a competent water-analyst has proved it to be harmless.

Attempts have been made to obviate the danger of water contamination from lead pipes in various ways, but not as yet with complete success. In some instances the pipes have been lined with other metals, such as tin or zinc; but, at least in some instances, a galvanic action has thus been set up, which corroded the conduits with great rapidity, and probably led, therefore, to still more dangerous pollution of the water-supply. Coating the pipes on the inside with coal-tar, bituminous varnish, solution of gutta-percha and of India-rubber, have also been experimented with, as yet with but partial success.

The injurious effects of lead upon the human system are displayed first, in the production of dyspepsia: later, obstinate constipation and a peculiar kind of colic, so common among painters from the influence of lead that it has received the name of "painter's colic;" and finally, disturbance of the nervous system, especially that peculiar form of lead-palsy called wrist-drop, in which the power to lift up the hand is more or less completely lost.

The presence of iron in a water, rendering it what is called Chalybeate, from the old Greek name for iron, renders it to many persons only a useful tonic, but in some people it causes severe headache and serious disturbance of the digestive organs.

Arsenic, copper, and mercury are rarely found in drinking waters in America, except in streams flowing near chemical works, or unless they are introduced designedly with some murderous intention. These metals may therefore be practically ignored in the consideration of water from a hygienic point of view.

### **Infectious Diseases from Contaminated Water.**

The principal acute diseases which are due to impure water are Cholera, Typhoid Fever, Diarrhoea and Dysentery; and, although it is only within a comparatively recent period that mankind has begun to realize its dangers from this source of these maladies, the accumulated evidence is already very conclusive. Among the remarkable outbreaks which go to prove that this mode of cholera propagation is not at all uncommon, may be mentioned the following, condensed from Mr. Simons' eighth report as medical officer of the English privy council, during the prevalence of cholera in England in 1865: A gentleman and his wife from the village



of Theydon-Bois, in Essex, had been lodging at the town of Weymouth for two or three weeks, and returned home towards the end of September. On their way home they passed through Dorchester, where the gentleman was seized with diarrhoea, vomiting, and cramps, which continued more or less during the next day and the day following, when he reached his own home. During the journey the wife also began to complain of pain in the abdomen, which was followed by diarrhoea and eventually by cholera, from which she died. A few days after their return the same terrible disease rapidly attacked other members of the household, so that, within a fortnight, in that one little circle, eleven persons had been seized with cholera, including the mother, father, grandmother, two daughters, son, doctor, serving-lad, serving-maid, laborer, and country-woman, and of these eleven only three survived, namely, the son, a daughter, and the serving-lad. Later, in the country-woman's family, there was another fatal case. It cannot well be doubted, concludes Mr. Simon, but that the exciting cause of this succession of events was in some way or other the return of the parents from Weymouth—of the father with the remains of choleraic diarrhoea upon him, of the mother with apparently the beginnings of the same complaint. But this is only part of the case, and the remainder teaches a most impressive lesson. All the drinking water used in the house came from a well beneath the floor of the scullery, and into that well, there was habitual soakage from the water-closet.

Another famous illustration is found in the history of the "tea-water pump" of Broad street, near Golden Square, London, which, during the cholera visitation of 1854, killed nearly 500 persons in a single week, in one of the fashionable localities of the city. It has long been known that water containing five or six grains of lime and magnesia to the gallon is much to be preferred for making tea to water of any other quality. This is because the lime precipitates the astringent matter of the leaf, yet does not interfere with the solution of the desirable constituents; and hence certain wells which have this proper proportion of mineral matter come to be valued very highly by persons of nice taste. At any rate, the Broad Street pump had in London the reputation of furnishing, in its cold and sparkling waters, a better medium for "the cup which cheers but does not inebriate," than was elsewhere to be found. When the cholera invaded this neighborhood, the wealthy residents retired to the fashionable suburbs which were still uninfected; but, to the surprise of many, the cholera broke out among them with terrible severity. The health officers soon discovered, however, that those who were attacked had sent in every day to their favorite Broad Street pump for their water-supply; and, by removing the pump-handle, they quickly put an end to the epidemic. One incident connected with this outbreak was very remarkable: A wealthy spinster, who was not so tired of life as to remain quietly in the path of the pestilence when it approached, withdrew to a suburb called Hamp-



stead. But her tea was particularly dear to her, and every day her serving-maid was sent three miles to the Broad Street pump for a kettle of tea-water, and this spinster and her maid were the only persons attacked with cholera in Hampstead.

A first and highly important warning, therefore, which these and many other similar occurrences give us is never to drink any water which, by any possibility, could have become contaminated with the smallest particle of discharge from the bowels of a person suffering from cholera or choleraic diarrhœa.

### **Typhoid Fever from Polluted Water-Supply.**

The remarks which have been already made with regard to the influence of impure water on the spread of cholera, apply with still greater force to the causation of typhoid fever. So common is this mode of propagation, that the assertion may be ventured that few readers of these



Fig. 1.

pages have not lost some near relative or beloved friend from this dreaded disease arising in this way, although the true source of the infection was perhaps, at the time it occurred, quite unsuspected. Sir Wm. Jenner, than whom no higher medical authority could well be quoted, in commenting upon this point, says: The spread of typhoid fever is, if possible,

less disputable than the spread of cholera by the same means; solitary cases, outbreaks confined to single houses, to small villages, and to parts of large towns, cases isolated it seems from all sources of fallacy, and epidemics affecting the inhabitants of large though limited localities, have all united to support, by their testimony, the truth of the opinion that the admixture of a trace of excrement, but especially of excrement from a typhoid-fever patient, with the water supplied for drinking purposes, is the most efficient cause of the spread of the disease, and that the diffusion of the malady in any given locality is limited or otherwise, and limited just in proportion as the dwellers in that locality derive their supply of drinking water from polluted sources.

In the above cut is shown how putrefying animal matters from a leaky drain and an overflowing cess-pool soak diagonally into the well and contaminate the well-water, which is pumped up and used by the family without, perhaps, a thought of danger from this terrible sanitary defect.

According to the late Dr. William Budd, it also appears to be highly probable that, when the poison of typhoid fever enters the system by drinking water, infection is much more certain than when it is disseminated by the air and is breathed into the lungs. In support of this statement, he instances an outbreak which occurred in Wales, where out of ninety or a hundred persons who attended a ball, fully one-third was shortly afterwards laid up with fever. Although the water was not examined, there was satisfactory reason to believe that it was polluted with sewage.

In the report of the American Public Health Association for 1873, Dr. Austin Flint gives an account of an outbreak of typhoid fever in Vermont which it was possible to trace, in the most circumstantial way, to the poisoning of a well in some such method as has been described. A young man travelling through that region by stage-coach was taken ill, and, when he could go no further, was left at a tavern in a little hamlet

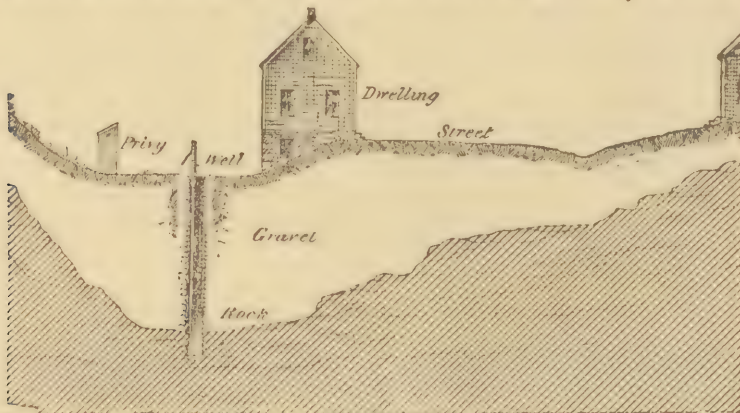


Fig. 2.

to be cared for, his illness soon proving to be typhoid fever. A small watercourse, in a shallow valley, divided the village into two portions, each of which consisted of half a dozen houses or less. In a few days, new cases of the fever made their appearance in that part of the hamlet to which the tavern belonged—every house, in fact, but *one* was invaded with this disease—whilst on the other side of the stream not a case occurred. It appears that the tavern well, which was the only one upon that side of the village, furnished the water-supply to all the families belonging there *but one*. That one family had had a quarrel with the landlord of the hotel, had consequently deserted the tavern well for a more distant supply of drinking water, and so escaped swallowing the specific poison of typhoid fever in the water by which all their neighbors were stricken down.

The above diagram teaches a most impressive lesson. It represents the relative positions of the well and privy of a house in Lynn,

Mass., with a view of the general arrangement of the bed-rock upon which the foundation layer of porous gravel rested. Five cases of typhoid fever occurred in this house during the year 1875, and seven more cases of the same disease, with one death, among other persons who used the water. Hence this well, like that of the Vermont tavern-keeper, became the centre of infection of typhoid fever for the whole neighborhood.

In such instances as this, there is no manner of doubt that the well-water becomes contaminated by the washing or soaking through the ground from cess-pits or other receptacles for the evacuations from the bowels of diseased human beings. Direct experiment has proved that, in a light porous soil, a well eighty feet deep will drain a portion of earth in the shape of an inverted cone, the point of which is at the bottom of the well, and the base of which is on the surface of the ground, where it has a diameter of about 600 feet, or nearly eight times the depth of the well, and so in proportion for shallower wells. Hence if, in the centre of a large village building-lot, 150 feet square, is dug the well of forty feet deep, for supplying the mansion with water, and at any one of the corners of the yard, as far distant as possible, is sunk a more or less shallow pit to serve as a cess-pool, the chance of contaminating the first pit with rain-water washings from the second pit or cess-pool is very great, and the danger of infecting the whole family with cholera, typhoid fever, and probably other maladies, should a single case of these diseases find access to the grounds, imminent.

#### **Danger in Farm-Houses from Polluted Water.**

Of course, the same conclusion holds good for country farm-houses or dwellings when, from motives of convenience, although there is space enough and to spare, but a short distance is interposed between the sides of the hole which is called the well, and which furnishes the drinking water, and the other hole near by which is called the cess-pit, and used as a receptacle for filthy, often poisonous, excrement. Moreover, there are no doubt many instances where, owing to the inclination of beds of sand or gravel, strata of rock, and so forth, impurities of these and other dangerous varieties may be carried, by underground currents, much further than the distances which have been mentioned as measured upon the surface of the earth. In other words, a cess-pool on a hill-side, 500 feet or more away from a well, may infect the water of the latter, if underground currents favor such contamination. Practically, it is beyond all question that, in multitudes of instances throughout the United States, the *cess-pits feed the wells*, and it is equally certain that *such wells feed the graveyards*, of villages and districts where so glaring and culpable neglect of hygienic precautions is allowed to occur. In this connection it cannot be too strongly impressed upon my readers that the filtration of water through the earth, even though sufficient to remove all visible impurities,



does not necessarily render it safe and fit for use; that is to say, clear water is not necessarily pure water, any more than cold air is necessarily pure air.

The accompanying illustration forcibly depicts the danger so much insisted on from the contents of cess-pools soaking diagonally through the soil. The well here represented was twenty-five feet deep, a portion being sunk into the bed-rock. The vault of the privy was only ten feet distant, and there was also a cess-pool in the garden below, and a stable close at hand on the left. The water was clear and of good taste, and had been used for many years; but the occurrence of typhoid fever in the house, to which these premises were attached, aroused suspicion, and on examination it was found to be largely contaminated with dangerous organic matter, doubtless from the vault, cess-pool and stable. Five cases of

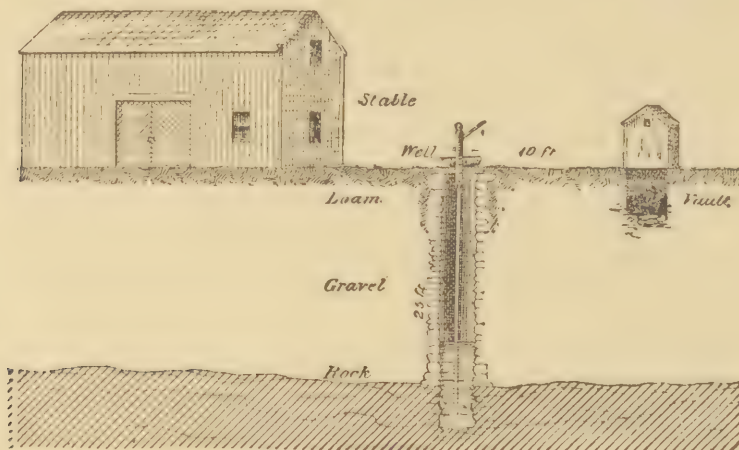


Fig. 3.

typhoid fever occurred in the family living upon this property, and several more cases, with one death, among neighbors using the well-water. Here the water was drunk habitually for years, by a score or more of people, without apparent injury, until the fall of 1876, when it doubtless became polluted with the germs of typhoid fever from some pre-existing case of that disease, perhaps by some such mode as that described by Prof. Austin Flint, and already referred to a few pages back.

### Diarrhœa and Dysentery from Impure Water.

The instances of outbreaks of these two diseases from contaminated water-supply are very numerous, and probably most of persons can recall examples of this kind. The impurities which produce diarrhœa and dysentery are suspended earthy matters, such as are found in most river-waters after a rain; suspended animal and vegetable material; sulphates and chlorides of lime and magnesia; and nitrates of ammonia and of

lime. Besides the numerous outbreaks traceable to direct sewage contamination, there are several instances recorded of indirect poisoning of a water-supply from this source, as in the following curious case: In the Salford, England, jail there was a sudden outbreak of diarrhœa of a choleraic type, which affected more than half of the prisoners; while of the officers and their families, who were distributed throughout the building, not one was attacked. The food of the convicts was examined and found to be good; it was evident, also, that the air did not contain the cause of the disease, because both classes above mentioned were under the same conditions in that respect. Suspicion was therefore directed to the drinking water. It was then discovered that, though the water supplying all parts of the prison was derived from the same source, there was one cistern for the use of the officers, and another covered cistern for furnishing to the prisoners their allowance, and that the untrapped overflow-pipe of the latter communicated with an open sewer. On the day of the outbreak of diarrhœa in the jail, the water from this cistern was observed to be colored and to taste unpleasantly. It had obviously absorbed sewer-gas, which had ascended through the overflow-pipe; and that this had been the real cause of the disease was indicated by the fact that the diarrhœa disappeared almost as rapidly as it had broken out, when the cistern was emptied and the pipe efficiently trapped. Dr. Wilson declares that, according to his experience, much of the diarrhœa which prevails in country districts during the summer and autumn amongst children is due to polluted water, drank either as it is drawn from the well or when mixed with milk, fraudulently or by accident. An old author mentions as a curious fact, which is highly suggestive to us at the present day as well, that ship's crews, when ordered to Tortola, in the West Indies, were invariably seized with fluxes caused by the water; but the inhabitants who used tank-, that is rain-water, were free from the diarrhœa, and so well was this known that, when any resident of Tortola was invited to dinner on board of a man-of-war, it was no unusual thing for him to carry his drinking water with him.

#### **Impure Ice as a Cause of Diarrhœa.**

The fact that ice is now used by almost all classes to an extent which entitles it to rank rather as a necessity than, as formerly, as a luxury of life, renders it important that its purity should be as jealously guarded as the water-supply. It is popularly believed that water frees itself from dangerous organic matter, as it does to a great degree from certain saline contaminations during the process of freezing, and also that the vegetable or animal germs of typhoid and other fevers are killed, or at least rendered sterile, by congelation of the water in which they exist. Both these ideas are, however, unquestionably erroneous, as has been repeatedly proved by the various experiments which ignorant hotel-keepers try,

without the least intending it, upon their guests, on a scale which would make the boldest vivisector stand aghast before the suffering inflicted, even if it were only upon the brutes which form the subjects of his researches. Such was notably the case in an epidemic of intestinal disorder which occurred at the watering-place of Rye Beach, N. H., in 1876. From the account of Dr. Nichols, who attended most of the patients, it seems that, early in the season, a mild form of disturbance of the stomach and bowels made its appearance among the guests of a particular hotel at this favorite summer resort. The symptoms were in general giddiness, nausea or vomiting, diarrhœa, and severe abdominal pain, accompanied by fever, loss of appetite, and mental depression. The disorder was at first attributed to the well-water of the place, which is strongly impregnated with sulphate and carbonate of lime and magnesia; but the peculiar grouping of the patients, almost exclusively among the sojourners at a single hotel accommodating about 300, whilst occupants of another hotel and of neighboring cottages, to the number of about 700 persons, were free from illness, strongly indicated some specific local origin. The well-water was almost immediately suspected of sewage contamination by the attending physician, but, on inquiry, it was found that the wells were all sunk in an elevated ridge, safely removed from drains, cess-pools, and other sources of pollution. Moreover, it was also ascertained that in some cases the individuals affected, being suspicious of the water, had limited themselves to other beverages, although, as afterwards transpired, they had not hesitated to use ice, either melted or otherwise. The drainage system of the establishment, which had recently been put in complete order, was found almost faultless, and the milk-supply of unquestionable purity; but on the attention of the physician being directed to the stock of ice provided for the guests, conclusive proof of its dangerous quality was promptly obtained. A resident of the village asserted that, on testing a portion of the same ice the previous winter, he had experienced nausea and distress the remainder of the day. Two gentlemen, having taken a quantity of the ice with them upon an excursion, during which they drank the water formed by letting it melt, were made violently ill. Both the house in which the ice was stored and the water from the melted ice gave off a decidedly disagreeable or even offensive odor. Finally, a visit to the pond from which the ice had been gathered disclosed the fact that much of the water in it was dark-colored, foul, and highly contaminated with filthy marsh-mud and decomposing saw-dust. Chemical analysis showed that both it and the suspected ice contained a large excess of organic and volatile impurities, including four one-hundredths of a grain per gallon of albuminoid ammonia. The conclusive test, however, of injurious quality pertaining to this ice was afforded by its disuse in the hotel, coincident with which was noticed an abrupt improvement of the symptoms in all who had previously been ill, and the entire absence, so



far as known, of any new cases. The ice was partaken of for a period of about six weeks by about 500 persons. Of these the majority escaped without injury; a large number suffered slight or temporary attacks of illness; and twenty-six adults manifested grave, continued, and characteristic symptoms. In Connecticut, the Board of Health informs us that, in several instances, attention has been drawn to sewage-contaminated ponds with ice-houses upon their borders, and that several isolated cases of typhoid fever, and one death, from the free use of ice polluted by sewage, had been recorded in that State during 1879. The curious natural experiment of the United States steamship Plymouth, elsewhere detailed, shows conclusively that the germs of yellow fever are not infallibly destroyed by a freezing, probably not by a zero temperature, and contributes its share of proof that impure ice, especially when gathered from ponds polluted by sewage, may constitute a prolific cause of disease.

Snow-water, pure and fresh as it seems whilst flowing in the sparkling streams which descend snow-capped mountains in our Western States, may be very dangerous to health in consequence of organic impurities contained in it. Mountaineers, to whose long observation and experience in the wilds some attention is due, attribute the origin of the so-called mountain fever to the melting of snows and the drinking of snow-water. This disease is apt to prevail in the Rocky Mountains in the spring, that is, during May and June, when the ice in the streams breaks up and the snow commences melting. In one instance, out of a party of 367 officers and men, 110 were affected with mountain fever in a few weeks after commencing to drink snow-water, which is described by the medical officer attached to the expedition as being cold, clear, and perfectly free from the alkaline taste generally found in waters of that region.\*

Although the poison of fever and ague is probably, as a general rule, conveyed into the human system by being breathed into the lungs, some cases seem to show that it may also enter the body by drinking water.

As general conclusions in regard to contaminated water, it may be stated that: 1st. An outbreak of diarrhœa arising in a community is almost always owing to impure air, impure water, or bad food. If it affects a number of persons suddenly, it is probably due to one of the last two causes; and if it extends over many families, almost certainly to water. But, as the cause of impurity may be transient, it is not always easy to find experimental proof. 2d. Diarrhœa or dysentery constantly affecting a community, or returning periodically at certain times of the year, is far more likely to be produced by bad water than by any other cause. 3d. A very sudden and localized outbreak of either typhoid fever or cholera is almost certainly owing to the introduction of the poison by water. 4th. The same statement is true in cases of ague or malarious

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\*See paper on Mountain Fever and Malarious Water, by Dr. C. Smart, *Am. Journal of the Medical Sciences*, Jan., 1878.

fever; and, especially if the attacks are serious, a possible introduction by foul water should be carefully inquired into. 5th. Where diphtheria proves particularly fatal, and carries off several members of a family, there is always reason to suspect contamination of the water-supply, which should be remedied as quickly as possible for the sake of the survivors. 6th. The introduction of the eggs of some of the intestinal worms, by means of drinking water, is proved in some instances and rendered highly probable in many others. People residing in districts where shallow dip- and draw-wells are in common use, seem to be particularly subject to parasitic worms in the bowels. 7th. Although it is not possible at present to assign to every impurity in water its exact share in the production of disease, or to prove the precise evil influence on the public health of water which is not extremely impure, it appears certain, says Dr. Parkes, that the health of a community always improves when an abundant and pure water-supply is given; and, apart from this actual evidence, we are entitled to conclude from other considerations, that abundant and good water is a primary sanitary necessity.

As a general guide to the water impurities that may be expected in waters from the various geological formations enumerated, the following condensed summary of the best known facts, as given by Dr. Parkes, will prove useful. The granitic, metamorphic, trap-rock, and clay-slate waters are generally very pure, often not containing more than from two to six grains per gallon of solid matter, which is chiefly made up of carbonate and chloride of sodium, with a little lime and magnesia. The organic matter is very small in amount usually, but shallow wells in disintegrated trap-rock may, of course, be fouled by surface washings or soakage. The water from millstone grit and hard oolite is also very pure, sometimes containing only four grains per gallon of mineral matters, which comprise the same saline materials as are found in granitic waters, with the addition of sulphates and a trace of iron. Soft sand-rock waters, on the contrary, are often impure, containing much sodium chloride or common salt, sodium carbonate, sodium sulphate, iron, and a little lime and magnesia, amounting altogether to from thirty to eighty grains per gallon. The organic matter may also be abundant, that is, to the extent of from four to eight grains to the gallon, or even more. Occasionally, however, these waters are quite pure. The loose sand and gravel waters also vary much in their composition, and in tolerably pure gravels, not near towns, the water is often very free from contamination. In many sands, which are rich in salts, the water percolating through them is, of course, much affected, the dissolved solids amounting sometimes to seventy grains per gallon, and consisting of sodium chloride, sodium carbonate, sodium sulphate, with calcium and magnesium salts, and a good deal of organic matter. The water from the sandy plains of southern France is said to contain enough organic matter to produce ague in those who drink it.

Water from the lias clays varies greatly in composition, but is often impure, even 217 grains per gallon of mineral matters having been found in one instance. The typical "hard" water, from chalk formations, is very sparkling and clear, highly charged with carbonic acid, and contains from seven to twenty grains of calcium carbonate, a little magnesium carbonate, and sodium chloride, with small and immaterial quantities of iron, silica, potassa, nitric, sulphuric, and phosphoric acids in combination; organic matter is usually in small amount, and it is therefore a good, comparatively wholesome, and pleasant water, which, though hard, softens greatly by boiling. The waters from limestone and magnesian limestone regions are also clear, sparkling liquids, of agreeable taste, but they differ from the chalk waters in that they contain usually more calcium sulphate, the sulphate of lime or gypsum, sometimes to the amount of twelve grains per gallon, and in dolomitic districts much magnesium sulphate and carbonate. They are not so wholesome as the chalk waters, are hard, and soften less on boiling. Waters from selenite rocks are sometimes highly charged with sulphate of lime, even to the amount of twenty grains per gallon. They are unwholesome to many persons, producing dyspepsia and constipation, alternating with diarrhoea; are hard waters, which soften little on boiling, and are unsuited to either cooking or washing. Genuine clay waters are not common, for very few springs exist in the stiff clay. The water of clayey districts is chiefly surface, and soon runs into converging streams. They often contain much suspended matter in the form of mud, but few dissolved constituents. Waters from the mixture of sand and clay brought down by the rivers, perhaps of former ages, and called Alluvium, are generally impure. The alluvial waters contain calcium carbonate and sulphate, magnesium sulphate, sodium chloride and carbonate, iron, silica, and often much organic matter, the total amount of solids reaching 120 grains or more. Occasionally the organic matter oxidizes rapidly into nitrites, and, if the quantity of chloride of sodium is large, it might be incorrectly supposed, from analysis, that it was contaminated with sewage. Surface and subsoil waters are often highly impure, and, although very variable in composition, are always to be regarded with suspicion until proved to be safe. Heaths and moors, on primitive rocks or hard millstone grit, may supply a pure water, perhaps slightly colored, however, with vegetable matter. Cultivated lands, with richly manured soils, frequently give a dangerous water, containing both organic and saline matters in large quantity. Some soils contain potassium, sodium, and magnesium nitrates, and give up these salts in abundance to water which soaks through them. In towns, and among human habitations, the surface and shallow-well water is often very unsafe, as already explained. It may contain large quantities of calcium and sodium nitrates, nitrites, sulphates, phosphates, and chlorides. Organic matter exists often in large amount and slowly oxidizes, forming nitric acid and



ammonia. Marsh-water always contains a large quantity of vegetable organic matter, it being not unusual to find from twelve to forty grains per gallon, and sometimes even more. Suspended organic matter is also common, but the amount of saline impurity is very variable. In water from graveyards, ammonium and calcium nitrites, and sometimes fatty acids, with much organic matter of animal origin, are met with. The water of a well at St. Didier, France, more than 300 feet from a cemetery, was found to be largely contaminated with ammoniacal salts and organic matter, which was left on evaporation. The water was clear at first, but had a vapid taste and speedily became putrid. Artesian-well water varies greatly in composition, being so highly charged with saline matter sometimes that it is quite undrinkable. The artesian well at Grenelle, France, contains enough sodium and potassium carbonates to render it alkaline to the taste, although it is used for the water-supply of the town. In some cases artesian-well water contains an appreciable amount of iron; in other instances, when drawn from the lower part of the chalk formation, or the green sand below it, it is tolerably pure. The temperature of the water is usually high in proportion to the depth of the well. Thus, for example, a well at Louisville, Kentucky, bored to the depth of over 2000 feet, discharges an immense volume of water, the temperature of which is seventy-five degrees Fahrenheit. The amount of air in the water of deep artesian wells is often small, and this circumstance, with the frequently elevated temperature and high degree of saline impregnation, is apt to make such wells very unsatisfactory as sources of water-supply. Lastly, water from wells near the seashore is apt to be brackish, and objectionable on that account, even though it does not contain much organic matter. Dr. Parkes mentions one instance where a bored well, 150 feet deep, near the sea, yielded water impregnated with 500 grains of solids, including 380 grains of chlorides, per gallon.

### **The Detection of Contaminated Water.**

As a general rule, the examination of drinking water, in order to determine its purity, and consequent safety as a beverage, involves a chemical and microscopical analysis, which should always be made when circumstances permit. Moreover, it must not be forgotten that water which is usually pure and wholesome, may be at any time polluted by the fouling of its source during heavy rains, the occurrence of floods, the alteration in the customary course and flow of sewage, manufacturing refuse, and so forth, above or below ground. Constant vigilance over the condition of the water-supply is, therefore, exceedingly necessary to health; but as complete investigation requires the skill of a professed analytical chemist, those methods of examination need only be described in detail which are especially used as giving us warning of danger, with a few of the simpler tests.

For hygienic purposes, then, we examine water in order to discover whether it contains any suspended or dissolved ingredients which are likely to be hurtful. Some saline materials often found in water, as already mentioned, are not injurious when present in small quantities only, whilst others, consisting of or resulting from putrefying animal matter, are at once recognized as very dangerous to health. In any instance, reliance must not be placed upon the results of single tests, but all the circumstances of the case must be searched out and carefully considered.

The examination of water by the ordinary senses, at least as regards its color, clearness, and lustre, may be made by filling any tall glass vessel, preferably one having perpendicular sides, with the fluid, and standing it over a sheet of white paper, comparing it if necessary with a sample of pure filtered or distilled water, placed in a similar jar alongside. Perfectly pure water has a bluish tint, but most ordinary waters have a grayish, greenish, yellow, or brown appearance. The best samples are tinged bluish or grayish. Green waters generally owe their colors to vegetable matters, chiefly microscopic plants, and are usually harmless, although certain bluish-green plants of this kind give rise to the disagreeable smell popularly denominated the pig-pen odor, and probably render the fluid unwholesome as well as disgusting. Yellow or brown waters are the most to be feared, as their color is often due to animal organic matter, such as sewage. It is sometimes the case, however, that a yellow or brown tint is due to decomposed vegetable material, such as peat, or decayed wood, and the fluid is then merely unpleasant and not hurtful. Water is also occasionally colored in this way by some salt of iron, although in most instances the metal is precipitated as oxide of iron in the sediment. The lustre or brilliancy of a water, which is recommended as a good test as to the amount of air which a specimen contains, can readily be judged by the eye; but the only satisfactory examination of the sediment must be made with the microscope, which ought to have a power of about two hundred and fifty diameters, although even an instrument of half that capacity will often reveal much of interest and importance in the deposit of a suspected drinking water.

#### **Taste is not Reliable in Testing Water.**

The taste of a water is a very uncertain indication in regard to wholesomeness. Of course, any badly-tasting water ought at once to be rejected, but some very agreeable waters, as far as their tastes are concerned, have proved to be dangerously contaminated with sewage of the vilest character. And yet many people are to be found all over the country who think that if a water is bright and clear it must be good; nay, if it is the drinking fluid of their own wells which is called in question, they will often indignantly resent the faintest suggestion that it can possibly be in

the least degree injurious to health. As remarked by Dr. Fox, however, such cases as that of the servant who, coming from an obscure village near the Dartmoor, in the southwest part of England, objected to the pure water of a distant town where she was in service, because it was devoid of both taste and smell, are becoming rare. As regards dissolved mineral matters, taste is of little use, and differs much in different persons. On an average, common salt is not recognized until it reaches the quantity of seventy-five grains per gallon, whilst carbonate of lime is perceptible when dissolved in a water to the amount of ten grains per gallon; iron, however, can be recognized by its astringent flavor in very small quantities, occasionally as minute an impregnation as two-tenths of a grain per gallon may be thus detected. A permanently-hard water has sometimes a peculiarly insipid or slightly saline taste, if the total salts amount to thirty-five or forty grains per gallon and the sulphate of lime or gypsum to six or eight grains. The taste of good drinking water is due entirely to the gases dissolved; water nearly free from the hardness of carbonate of lime, held in solution by carbonic acid, such as distilled water, is not so pleasant as the brisk highly-carbonated waters; it may be called flat, but it is difficult to define the kind of taste or the absence of it. To observe the smell of a water, a portion of it should be poured into a wide-mouthed bottle or flask, so as to fill about one-third of its capacity, and then well shaken up. If the smell is unpleasant, the fluid may be at once pronounced unfit to drink. Should no smell be discovered, the flask should be gently heated by placing it in hot water of about the temperature of  $110^{\circ}$ , and again shaken, and if there is still no odor evolved, a little caustic potash should be added to the warm water. Any unpleasant odor which may be given off after this further test indicates with tolerable certainty that the water contains organic impurities in considerable quantity. The occurrence of a milky precipitate of lime, on the addition of the caustic potash, will at the same time show that you are dealing with a hard water. This test by the sense of smell is more delicate if employed in the following manner: fill a pint bottle two-thirds full, cork it tightly and set it at a window where it will be exposed to the sunlight all day. The next morning, after slightly warming the bottle, uncork it and examine the odor, which, if at all putrid, indicates organic matter in dangerous amount.

Although the general characters of a water, when examined as directed above, give only an imperfect idea of its value, they are yet important when no other investigation can be made. If the water be colorless, clear, free from suspended materials, of a good lustre, yet not too brilliant, devoid of smell and taste, except such as are recognized as characteristic of a safe and usable water, we shall in a majority of cases be justified in pronouncing it a wholesome drinking fluid; whilst, according to the degree in which it deviates from these characteristics, will we proportion-



ately be sustained in regarding it with grave suspicion. Visible suspended matter is probably often the most dangerous, although there is little doubt that the microscopic germs of various diseases may exist in small aggregations without being recognizable at all by the naked eye of even the most practised observer; and, of course, the metallic impurities, such as lead and copper, for detecting which rules have already been given, must often escape discovery by any examination which does not include the application of chemical tests.

The one of these chemical reagents which it would be well to apply in every instance where it is possible to do so, is the "Nessler's test," an ounce of which may be procured from almost any good chemist for twenty or twenty-five cents. It constitutes a test for the products of decomposing animal matters, especially sewage materials, including human and animal excrement, and is therefore capable of giving timely warning against the most dangerous of the common pollutions of drinking waters. In the whole round of chemical analysis there is no determination, which surpasses that of ammonia from putrefying animal matter, by this method, in point of delicacy. It is questionable whether any other approaches it. The Nessler reagent is said to be capable of indicating one part of ammonia in twenty million parts of water, and even this assertion, surprising as it may seem, is given as an understatement of the delicacy of the test. Such being the characteristic of this way of calculating the ammonia, the great advantage of causing determinations of organic matter to depend on measurements of ammonia will be manifest to every one.

In order to make use of this reagent, fill an ordinary wine-glass or small goblet which will hold from two to four ounces, nearly full of the water it is wished to examine, and add three or four drops of the Nessler's solution. If a yellow or brown color, or a brownish precipitate, be produced, the water contains ammoniacal salts. As a rule, this should be regarded as a very suspicious circumstance, and should the coloration be well marked, it is almost sufficient of itself to condemn the water for drinking purposes. If a milky or curdy precipitate is also formed, it shows that the fluid is a hard water, and more or less unfit for washing. Should this whitish precipitate be excessive, it hides to a certain extent the yellowish color indicative of ammonia, so that it is necessary to take a fresh sample of the water, add to it a few drops of strong solution of caustic potash or soda, and after the precipitate of lime which is thus caused to fall has subsided, test for ammoniacal compounds with the Nessler's reagent.

Clark's soap-test for determining the hardness of water, is prepared by dissolving a small quantity of soap, say one ounce in half a pint of a mixture of equal parts of alcohol and water. It is used by dropping it into a measured quantity, such, for example, as an ounce of the water to be tested, until the fluid when shaken begins to form a beady lather—the

relative number of drops required to produce this effect nearly indicating the comparative degrees of hardness of the waters undergoing examination.

This soap-test may be used to decided advantage in all "hard-water" districts, and every one should test his water-supply at the earliest opportunity, with it, with the Nessler's reagent for organic ammonia indicating pollution by sewage, and with the sulphide of ammonium for contamination with lead. And the application of these two latter tests is important, even although the drinking water in question has been in use for a long time by various members of a family without apparent injury, for many instances are on record in medical books where chronic derangements of health have been due to impurity of the water taken into the stomach, and yet this source of injury has been entirely unsuspected until a chemical examination of the water-supply has revealed the insidious origin of the trouble. A wise precaution when travelling, especially in unhealthy districts or during an epidemic of any kind, is to drink none but boiled rain-water, which you can make sure has not been exposed to contamination by lead pipes, roofs, or cisterns. To be effectual, the boiling ought to be continued briskly for half an hour or longer. Rain-water is preferable in limestone regions, because the hard water containing lime is partially or not at all improved in this respect by boiling, and gives rise to serious diarrhœa in many of those unaccustomed to its employment. Such hard water is also probably one great cause of the very painful calculous disorders.

#### Purification of Water.

When water has been proved by any of the various methods already described to be impure, or even suspicious, the best plan is, of course, to seek some new and uncontaminated supply, avoiding even the chance of introducing into our systems any of the disease germs or poisons which have been referred to. In many cases, however, this change of source may be for a time impracticable, and under such circumstances some method of purifying the water, as far as possible, should be immediately resorted to.

Foul water is rendered much more palatable and rather safer by exposure to the air in divided currents; as, for example, when poured from a sieve, a sheet of perforated tin, or broad piece of wire gauze, as is done in Russia on a large scale. Boiling, with frequent or constant stirring, is another method, as already suggested, and one which should never be neglected during cholera epidemics, or when typhoid fever is especially prevalent. It is a precaution which should always be instituted with the water drunk by young children, or mixed with their milk, whenever they are removed from the water-supply to which they have become accustomed. In this way the first onset of that diarrhœa and cholera infantum,

or summer complaint, which, if it gains a hold upon them, so frequently proves fatal to their frail organizations, may often be entirely prevented.

It has been customary in both India and China, for many centuries, to purify water from suspended matters by adding powdered alum to it. This plan is peculiarly efficacious if the contaminated water contains a small quantity of carbonate of lime, since by the subsequent reactions more bulky precipitates are formed and a larger quantity of the suspended organic impurities are carried down with them, to the bottom of the vessel in which the process is performed. The quantity of crystallized alum used should be six or eight grains to the gallon, or about half an ounce to the barrel of water, and the alum should be in a finely pulverized condition. No taste is communicated to the water by this amount of the aluminous salt, and experiments upon a large scale in India show that it not only improves the appearance of a water, but destroys, at least in many cases, its power of producing diarrhœa in those who drink the purified liquid.

The permanganate of potash solution, called also 'Ondy's red fluid, is much used abroad for purifying foul and ill-smelling waters, particularly when contaminated with putrefying vegetable substances. A deep purple solution of the permanganate should be added by tea-spoonfuls to four or five gallons of the water undergoing purification, until a very slight pink tint is produced; then let stand five minutes, and if the pinkish hue has faded add another half tea-spoonful, and if necessary still another, and let stand for six hours; then treat with alum, as before directed, let stand eighteen hours, and filter. One objection to the permanganate process is that the finely divided oxide of manganese, which is separated, often communicates a yellow tinge to the water, which, though not injurious to health, is somewhat repulsive to the eye. Sometimes this yellowish color is removed by the alum treatment, and at any rate it can be gotten rid of, if filtration is employed. This method is particularly useful for destroying disagreeable odors in water.

The great remedy for suspended impurities in drinking water is, as everybody knows, found in filtration, but it is not as generally understood that this purifying effect is chiefly exerted upon the least injurious ingredients of polluted water. Experiments on a large scale have proved that, whilst the effects of good filters or filter-beds in improving the appearance and taste, as well as to some extent the odor, of a contaminated water are highly satisfactory, their influence in removing the organic impurities, which are so especially dangerous to health, and include nearly all the disease poisons which find access to human beings through drinking water, is very slight and totally unreliable. On dissolved mineral matters, the sand and gravel of a good filter exerts a considerable action. Much of the chloride of sodium or common salt in a brackish water may



be gotten rid of through its agency, and Professor Clark has stated that even lead may be removed by filtering through a thick stratum.

An immense variety of filters are offered for sale in this country, and testify, by that very diversity, both to the wide-spread demand for some efficacious method for purifying water, and also to the universal failure of all of these pieces of apparatus, however ingenious they may be, to accomplish the desired object under all circumstances. According to Dr. Parkes the essentials of a good filter are the following: 1st. That every part of the filter shall be easily got at for the purpose of renewing the medium employed, or of cleaning it when that can prove sufficient. 2d. That the medium constituting the filtering material have a sufficiently purifying power, and be present in sufficient quantity. 3d. That the medium yield nothing to the water which may favor the growth of low forms of life. 4th. That the purifying power be reasonably lasting. 5th. That there shall be nothing in the construction of the filter itself that shall be capable of undergoing putrefaction or of yielding metallic or other impurities to water. 6th. That the filtering material shall not be liable to clog, and that the delivery of the water shall be reasonably rapid.

The general principles upon which filters are constructed are well illustrated in Parkes cottage filter, which forms one of the simplest and cheapest pieces of apparatus for purifying water. It is thus prepared: Get a common earthenware flower-pot of large size and cover the hole in the bottom with a bit of zinc wire-gauze or of clean washed flannel, which requires changing from time to time, then put in the pot about three inches depth of gravel, and above that the same depth of white sea-sand washed very clean; four inches of animal charcoal covered with a thin stratum of coarse gravel, or with a piece of slate, to keep it in place, constitute the last layer; and the water to be purified should be poured in on the top and received from the hole in the bottom into a large glass bottle provided with a funnel. The charcoal in this arrangement will unfortunately from time to time become clogged, and must then be cleaned by heating it over the fire in shovel, taking care only to carbonize the organic matter without burning the coal. The sand or gravel should also be cleaned or renewed from time to time.

The most important substances which enter into the construction of the various patent filters are sand and gravel, animal charcoal, spongy iron, and a substance called carfural, which appears to be a mixture of the iron and charcoal. All filters when first put into use should be washed out by passing through them from ten to twenty gallons of the cleanest water which can be obtained, as the filtering medium generally yields something to water in the beginning of its service. Again, after a certain period, varying with different forms of apparatus, the filtering media not only cease to be efficient, but even begin to impregnate the water which

is passed through them with dangerous impurities. So often is this the fact that cases of illness have been traced to this cause, and some persons have thought that the dangers of filtration were greater than those of unfiltered water. There is no doubt that the practice of depending for years on the efficiency of a filter, which has never been cleaned nor had its material renewed, is very hazardous, and there is still more danger to be apprehended from many of the "self-cleaning" filters, which, in the words of their advertisements, "require no attention." It is not possible to state exactly the length of time any filtering medium will remain efficient, so much depending upon the condition of the water and the quantity passed through. But animal charcoal, in granules or powder, ought to be examined at least every three months, by testing the water which comes from it microscopically and chemically as has been already directed. If this cannot be done, the charcoal should be cleaned every three months, as a matter of precaution, by heating it to dull redness in a closed crucible, and then washing it repeatedly with pure water. Failing this, boiling it with dilute solution of permanganate of potash or with a solution of some mineral acid, such as sulphuric acid, is the safest plan. After this it may be exposed to the sun and air, thoroughly washed, and used again. Spongy iron may generally be depended upon for a year, and, unless the water is very impure, for even a longer time. It should, however, be renewed at the end of twelve months, and if circumstances prevent this, it may be cleaned by exposing it to a low red-heat in a furnace, and then thoroughly washing it. Purifying it with permanganate of potash and acid must not be attempted. Filters where the material is cemented up and cannot be removed, ought to be abandoned altogether. Strainers of sponge, or any similiar material which is not incombustible, are highly objectionable, but asbestos forms an excellent strainer, and can be heated to redness so as to destroy all organic matter which it has filtered out of the water passing through it, as often as is necessary.

Some of the cheaper forms of filters are enclosed in sheet tin, or have sheet-tin reservoirs for the filtered water. These are especially dangerous, because the lead in the solder by which they are held together is liable to be dissolved, and lead to all the evil results of lead poisoning. The same danger of lead contamination from glazed earthen vessels must also be guarded against, as the bright surface upon many of the inferior kinds of crockery is largely composed of this dangerous metal. Opinions differ in regard to the safety of galvanized-iron conduits and reservoirs, and it is therefore best to avoid their use if possible, and to test the water flowing from them occasionally, if circumstances render their employment necessary.



### Hygienic and Physiological Uses of Water.

A moderate quantity of water, properly taken up by the stomach, is indispensable to life. In truth water, as already remarked, is an essential constituent of all animal organisms whilst in active existence, and is found, though in widely different proportions, in every one of the various organs of our bodies. A certain amount of water is given off every instant of our lives, by perspiration from the skin, by exhalation from the lungs, by the kidneys, and at intervals from the bowels, and of course this loss of aqueous fluid must continually be compensated for by taking into the stomach a corresponding quantity of fluid. In health the human system has the power of availing itself of just the right portion of water which is offered to it, any excess, beyond what is essential to the maintenance of the various solids and liquids of the body in their complete integrity, being promptly eliminated by the perspiration and the secretion from the kidneys. In disease, however, as is well known, such for example as dropsy in its various forms, water is not properly thrown off, and accumulates under the skin in immense quantities, producing painful or dangerous distension and ulceration of the cuticle, and sometimes directly causing death. The results in man from an insufficient supply of water are not so well known as might be expected, since the circumstances generally interfere with an accurate observation of the phenomena displayed. Usually the sensation of thirst, the most delicate and imperative of all our feelings, except that which impels us to secure a due supply of air, never permits any great deficiency for a long time; but when circumstances prevent a free supply of water, it is well known that the desire for drink becomes so great, that men will brave any danger or undergo any pain to satisfy it. The exact condition thus produced has not been precisely determined, but from certain incomplete experiments upon animals and men, it would appear that a lessened amount of water in the body diminishes the important operations of eliminating carbonic acid from the lungs, and various effete and poisonous substances by the bowels and kidneys. The more obvious effects produced on men who are deprived of water for some time, that is until actual suffering is endured, are, besides the feeling of most painful thirst, a general lowering of both muscular strength and muscular vigor. After a time exertion becomes almost impossible, and it is wonderful to see what an extraordinary change is produced, in an amazingly short time, if water can then be procured. The abundant supply of water is therefore a matter of most urgent necessity when men are undergoing great muscular efforts, but it is very important that this supply should be by small quantities of water frequently taken, and not by any large amount swallowed at any one time. Complete deprivation of water usually proves fatal in from three to five days, and death, under such circumstances, is preceded by a thirst so intolerable that no other torture can compare with its agonies.



Although healthy people, who swallow an excess of water, find that this superabundance is rapidly eliminated by the various outlets provided for its disposal, the introduction of too much water into the stomach is not without its unfavorable influence upon health. In the first place, at the time it is imbibed, it unnecessarily distends the stomach; and, by diluting the gastric juice, prevents that liquid from properly dissolving the food. Too abundant draughts of water, therefore, fatigue the digestive apparatus, and without any other aid sometimes suffice to bring on dyspepsia. Such a result would probably be much more common were it not that the distension is usually of short duration, the superabundant liquid being rapidly absorbed from the mucous membrane lining the stomach into the blood. Moreover, the fluid, when gotten rid of from the skin, the kidneys, and so forth, does not emerge as pure water, but in the state of a product of secretion; that is to say, it is found that the excess of liquid does not merely dilute the perspiration and the urine, but augments the total quantity of solids which they contain, and so becomes a real drain upon the entire system. Sometimes, when the superabundant water is carried off by the bowels, an exhaustive diarrhœa may be set up. These physiological facts are obviously capable of very valuable hygienic applications in our efforts to eliminate poisons and other disease-producing agents from the system, or we may, in accordance with them, often succeed in exciting the mammary glands during nursing to a freer secretion of milk.

Water of different temperatures has very different effects upon the individuals who imbibe it. When a healthy man whose skin is not moist with perspiration drinks ice-cold water in moderate quantity, the first influence upon the mucous membrane of the stomach is to reduce its temperature. But very soon a reaction takes place, and a stimulating effect is produced which, in cases of inactivity or atony of the stomach, is sometimes highly salutary. If a person who is freely perspiring imbibes a large amount of ice-water, the effects are sometimes very different and far more serious. Sometimes, it is true, the sudden chilling of the stomach is promptly followed by reaction, accompanied by a sensation of coolness and comfort, but on other occasions the cold liquid brings on a chill and checked perspiration, with its dangerous complications of congestions and even inflammations of the vital organs of the body. The evil effects of drinking cold fluids in large quantity when overheated, are chiefly manifested in the nervous system, in the digestive apparatus, and in the lungs. The nervous phenomena are severe pains in the stomach, spasms like those of lockjaw, fainting, and sudden death—the latter probably from spasm of the muscular structure of the heart, by which its pulsations are immediately arrested. Many instances of fatal results of this kind are recorded. The rapid development of acute inflammation of the stomach and bowels, immediately following the imbibing of very cold water in large amounts, under these circumstances, is too common to allow of any

doubt that it is thus produced. The symptoms of such a misfortune are pain in the stomach, spasmodic vomiting, dysentery, soon running on into active inflammation of the stomach and intestines, or even that fatal disease, peritonitis, or inflammation of the membrane covering the bowels. In the lungs, spitting of blood, pleurisy, and bronchitis are the maladies which have been observed under these circumstances. According to Becquerel, the severity of all these various disturbances of health depends upon the four following conditions: 1st. The heat of the body at the time the water is imbibed. 2d. The actual emptiness of the stomach. 3d. The bulk of fluid drunk in a given time. 4th. The low temperature of the draught. A combination of all four of these conditions in a highly unfavorable degree promotes, of course, to the greatest extent, the chances of injurious result. Ice-water should therefore be drunk in small swallows, holding the fluid in the mouth for a few seconds before introducing it into the stomach. When, by the incautious use of very cold water, any of the symptoms just described are brought on, they may sometimes be quickly relieved by swallowing a considerable bulk of some warm fluid, such as hot tea or coffee.

The effect of warm water when imbibed into the stomach is neither agreeable nor healthful. It is very apt to act as an emetic, occasionally produces diarrhoea, and has a tendency to render the digestive processes languid and feeble, perhaps in part by the sedative influence which it exercises upon the nervous system. Its value as an emetic in cases of poisoning should never be lost sight of, since it is often the remedy of this class which can most promptly be procured, and a few minutes may in some instances make the difference of life or death to the patient. Hot water, provided it is below a scalding temperature, has many advantages over both iced and tepid liquids as a beverage. It stimulates the entire organism by increasing the amount of heat which it contains, renders the circulation more active, excites the digestive functions as well as those of the skin, and results in perspiration more or less profuse, according as the individual partaking of it is well or illy-protected from external cold. Indeed, hot drinks are probably the best and most convenient diaphoretics, or agents which promote perspiration, we have at our disposal. Numerous cases are, however, on record of children who, by attempting to drink scalding tea or other liquids, have brought on that partially inflammatory, partly dropsical swelling of the upper edge of the larynx, called œdema of the glottis, for which the operation of tracheotomy was requisite in order to save them from immediate suffocation.

### Baths and Bathing.

The waters ordinarily in use for bathing purposes do not differ much in their characteristics from our common drinking waters; and, although there is not quite the same danger of infection with disease-poisons from

having the body immersed in polluted water, there exists, nevertheless, a definite risk from such a procedure, which ought on no account to be lightly undergone. The employment of baths goes back to the periods of the highest antiquity in the world's history, and bathing was indulged in, often to great excess, by the Greeks and Romans. So important are baths in most warm countries, that the Jewish and other Oriental religions enjoin frequent ablutions as a necessary part of the ceremonials in their creeds, thus no doubt largely contributing to the health and well-being of their devout disciples.

In order to understand the true value of bathing, the reader's attention must be asked for a few minutes to the anatomy and physiology of the

FIG. 4.



VERTICAL SECTION OF THE HUMAN SKIN, SHOWING CELL-ARRANGEMENT.

epidermis or cuticle, commonly spoken of as the scarf skin. This is the part which is raised up by water collecting underneath it when we blister our hands in working, or are blistered by the sun, by artificial heat, or by a blistering plaster. The epidermis is made up of millions of little oval and flattened bodies called epithelial cells, about one one-thousandth of an inch broad, packed together like stones in the wall of a house, except that, in proportion to the size of the epithelial cells, the skin is much thicker than any ordinary house wall.

Figure 4 represents the arrangement of the epithelial cells in the epidermis, being a picture of a vertical section, that is, a thin slice cut at right angles to the surface of the skin, when very highly magnified. At *a* are seen young, actively-developing epithelial cells. At *b*, *c*, and *d*, older

skin, which is, of course, the portion of the human body most directly interested in the process. Everybody knows, by the uncomfortable experience of having his skin knocked off or cut through in some little spot, how important this external covering is to us. But, although so necessary to our comfort as a protection from the air and from external violence, our skins—or integuments, as anatomists call them—have other and scarcely less useful offices to perform in the animal economy. In order, apparently, to make sure that the surface of his body shall be well guarded, man has been provided with two entire skins, the outer of which is named the



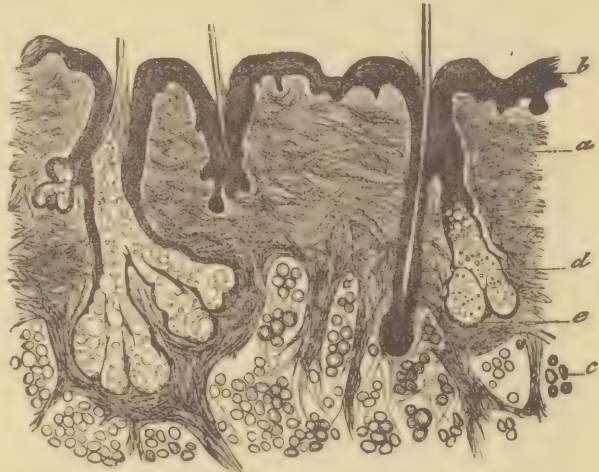
cells in the process of being pushed toward the surface by their younger brothers, which are growing rapidly beneath them. At *e* is exhibited the thin, flattened cells of the outer horny layer, which are almost ready to be cast off, or washed away in taking a bath. *f* is the basement membrane from which the epithelial cells grow, and *g* the connective tissue as it is called, of the true skin beneath. In some places where the epidermis is unusually thick, as, for example, on the palms of the hands and the soles of the feet, the wall, or rather pavement, of epithelial cells is more than a hundred deep. The outside layers of the epidermis are not supplied with any nerves, and are therefore totally insensible. Cutting and pricking them does not cause any pain, as is shown by the common schoolboy's trick of running pins or needles underneath the surface of the epidermis of the balls of the fingers and palm of the hand. The inner layers of the epidermis are made up of epithelial cells, which in Indians and negroes contain the red or black coloring matter which gives their skins the characteristic tint. This group of tiers of cells in which is formed, out of the blood, the coloring matter peculiar to each race of mankind, except the white or Caucasian, is called the rete mucosum. Immediately under the rete mucosum is the true skin or cutis vera,

called also the corium or derm. This is generally thicker than the epidermis, and has underneath it a cushion of fat. When tanned it constitutes leather, and by looking at a piece of good sole-leather, any one may gain a clear idea of how strong and how fibrous the true skin is.

Figure 5 shows a vertical section of skin, less magnified than the last illustration, in order to exhibit both the epidermis, the cutis vera, and part of the layer of subcutaneous fat. In this latter are seen the fat cells, *c*, which are little bags containing globules of oily matter, irregularly grouped in the interspaces between bundles of fibrous tissue. One large, *e*, and two small hairs, are also displayed, one of each having at the side of their roots a sebaceous gland, *d*, which furnishes the very important oily matter to the hair.

The cutis vera is supplied with a great many little nerves, which make

FIG. 5.

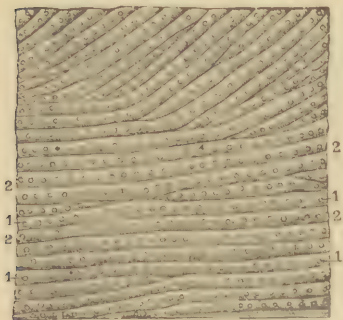


VERTICAL SECTION OF THE HUMAN SKIN, SHOWING HAIRS, FAT, AND CELLS.

it very sensitive to pricking, or cutting, or burning; and it also contains an immense number of tiny blood-vessels, which are always ready to pour out a drop or two of their crimson fluid contents through the slightest wound. The surface of the cutis vera is everywhere covered with minute projections called papillæ, about one one-hundredth of an inch high. In each papilla there usually terminates the tiny twig of a nerve, and it is to these nervous twigs that the sense of touch is chiefly due. The papillæ are especially numerous on the ends of the fingers, where they are arranged in rows and covered by the epidermis. These rows are easily seen on the balls of the fingers and on the palms of the hands. The papillæ are particularly abundant upon the tip of the forefinger, and this part is therefore endowed with the greatest perfection of the sense of touch. If the palm of the hand is looked at very carefully with a magnifying glass, it is easy to see, in rows upon the tops of the ridges which cover the papillæ, a great number of little holes.

In this figure are well shown the rows of pores as they appear upon the palm of the hand, when looked at with a magnifying glass capable of

FIG. 6.



THE SKIN OF THE PALM OF THE HAND, AS SEEN UNDER A MICROSCOPE.

enlarging the object four times in length and four in breadth, rendering it, of course, apparently sixteen times as great in area as it really is. This is usually called among microscopists a magnifying power of four diameters, and is represented thus,  $\times 4$ . 1, 1 indicate the pores of the skin and 2, 2 the furrows between the ridges, upon the tops of which are situated the pores or mouths of the sweat-glands.

These holes are called the pores of the skin, and are the external orifices or mouths of the sweat-glands, which have such an important function to perform in the human system, namely, the getting rid of so much used up and injurious matter. Each sweat-gland is composed of a delicate little tube, which runs down into the depths of the skin, generally almost or quite to the layer of subcutaneous fat, and there is coiled up into a ball, which, when highly magnified, looks a good deal like one of the balls which earth-worms sometimes roll themselves into. These tiny little glands are each very insignificant, but they make up for their individual minuteness by their immense number, as it is estimated that they average about 2500 in every square inch of the surface of the skin, and that the total length of the glandular tubes, if ravelled out and placed end to end, would be nearly ten miles. Under ordinary circumstances, the sweat-glands secrete from the blood and exude upon the surface of the skin about enough water to compensate for the natural evaporation,

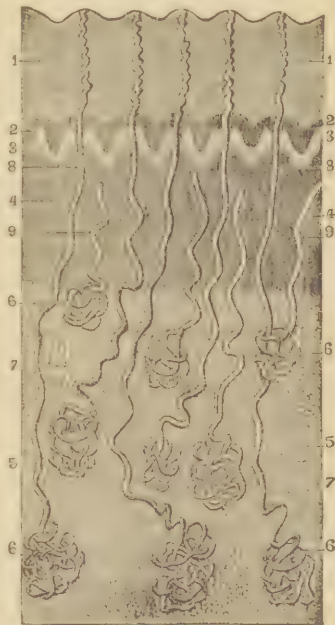


and so keep the surface of the human body pleasantly moist. But during active exercise, and in the course of certain diseases, a much greater amount of water is drained off from the interior to the surface than can evaporate, and this fluid stands in drops upon the skin, especially of the forehead, as perspiration. Since this perspiration is found, when examined chemically, to contain a considerable quantity of the refuse material of the body, which acts like a poison if not properly cast off, it is easy to understand how stopping up the pores, through which empty the ten miles of drain-pipe already mentioned, by not keeping the skin clean, must necessarily be very disadvantageous to health. Moreover, besides purifying the blood by the secretion of perspiration, the sweat-glands, provided they are not obstructed, are very useful in contributing to regulate the animal heat.

The marginal illustration gives a view of the sweat-glands of the palm of the hand, each terminating at the top of a ridge in one of the pores shown in the last figure. 1 is the epidermis; 2, its lower layer of colored cells, constituting the rete mucosum; 3, the papillæ of the cutis vera, or true skin; 4, the cutis vera; 5, subcutaneous connective tissue containing fat cells; 6, 7, 8, 9, sudoriparous or sweat-glands.

In addition to the sweat-glands, another set of glandular bodies, called the oil-glands, are found in the skin. These have for their office the supplying of an oily material, which serves to keep the skin soft and flexible, so that it will not readily crack. This oily matter is formed inside of the cells which line the oil or sebaceous glands, as they are called, and after the cells become so swollen as to burst, the oil flows out and helps to fill up the hollow of the gland and its outlet, or duct, which empties upon the surface of the skin. This process goes on continuously, and the fatty substance is therefore pushed out gradually to where it is wanted (see Fig. 5). Upon the nose, and especially at its side, these sebaceous glands are very large, and, when filled with their secretion, can be readily seen. If the hardened secretion is pressed out, it looks like a small worm with a black head, but it is only a tiny rod of fatty matter and worn out epithelial cells, the top of which has become black and dirty by having dust from the air stick fast to it. The oil-glands of the skin are also very abundant in the parts of the body covered with hair, where their secretion does a very

FIG. 7.



SWEAT-GLANDS OF THE PALM OF THE HAND.



important service in keeping that hair from becoming dry, harsh, and brittle.

The dangerous effect of stopping up ten miles of sewer-pipes, as the natural drainage-tubes which the sweat-glands constitute may be denominated, has already been adverted to, and many years since was experimentally shown by the cruel and speedily fatal process of varnishing a dog all over after cutting off his hair. But even in very filthy people, the coating made up of oily matter from the sebaceous glands of the skin, of saline materials from the perspiration, of epithelial scales from the epidermis, and of external dirt, is never so dense and impervious as a coat of varnish, so that perspiration still goes on through it, although much less efficiently than when the body is kept clean by proper bathing. We do not know exactly how much of the purification of the blood is accomplished by the pores of the skin, but there is little doubt that no insignificant part of the injurious worn-out material of the body is thus cast off. Hence, of course, whenever these openings are choked up by dirt, so that they cannot do their work properly, some of this duty of purifying the blood is thrown upon certain internal organs, such as the kidneys or intestines, and should these happen to be weak, diseased, or already overtasked, serious disturbance may be quickly brought on throughout the whole system. Again, this same obstructed condition of the pores of the skin interferes also very much with the function of aiding to regulate the bodily temperature, by permitting a more or less abundant evaporation from the cutaneous surface, and hence people with dirty skins are, other things being equal, more liable to take cold on exposure to changes of temperature. The words, "other things being equal," form an important limitation to this statement, because, after a filthy person has just had a thick coat of dirt removed by washing, he is, in consequence of this unprotected condition, left even more susceptible to cold, as will be pointed out when speaking of the warm bath.

It is probable that most of the troublesome and disgusting skin-diseases which render the lives of so many people utterly miserable, are, if not due to contagion, or animal and vegetable parasites, produced by these two agencies just spoken of, namely, first, the local irritation of the skin by dirt, worn-out epithelial scales, dried perspiration, and exuded oily matter; and second, the general derangement of the health arising from unwholesome blood, which has not been purified as it ought to be by the operations of the obstructed sweat-glands. Hence, any individual who will take the simple and delightful precaution of bathing often enough to keep the cutaneous surface in good condition, may be almost sure of escaping a large class of skin-diseases, the remainder being almost equally avoidable, as will be pointed out in the appropriate place.

### Hygienic Use of Baths.

Coming now to the detailed consideration of water as applied to the human skin in the form of a bath, in order to accomplish the important hygienic purposes described, it is obvious, in the first place, that temperature has a powerful influence in this respect. Baths, then, have been variously divided, in accordance with the sensation which the water employed produces upon the skin, and the best classification is, probably, cold, tepid, warm, and hot baths.

The range of the cold bath varies more than that of any other kind, extending, as it does, from  $84^{\circ}$  Fahrenheit down to  $33^{\circ}$  of the same scale. The lower temperatures included between these limits would, of course, test the endurance of even the strongest to encounter safely the severe shock which is generally produced by the sudden application, and still more the prolonged immersion of the body in a water so near its freezing-point; but from  $84^{\circ}$  to  $74^{\circ}$  the reaction required is so slight that few persons who are not actually invalids are too feeble to manifest it. The first effect of plunging into cold water is to depress the powers of the system, and this depression is in a general way proportionate to the difference between the temperature of the water used and the normal heat of the body, namely,  $98.4^{\circ}$ . After suddenly entering a cold bath, the pulse and heart will be found to beat less violently and at a slower rate; a shock is experienced throughout the whole nervous system, more or less severe, according to the lower or higher temperature of the fluid, and the contracting effect of the cold aids the spasmodic contraction occurring in the small blood-vessels to drive the blood to the inner portions of the body, and allow the surface to become quickly chilled. But if the cold is not too severe, or the individual is not exhausted by fatigue, or enfeebled by disease, a change in these conditions promptly manifests itself soon after leaving the bath, especially if the skin is rapidly dried by friction with some absorbent substance. The heart and pulse return to their normal rate of movement, the nervous system recovers from the shock which it has undergone, the blood flows back to the surface of the skin, and a glow of renewed warmth is felt throughout the entire body. This agreeable change in the condition of the circulation and the sensations, is called the *reaction*, and constitutes our very best guide to the employment of cool or cold bathing. If the water of a bath has been colder than is adapted to the strength of an individual's constitution, reaction comes on but slowly, and several hours may elapse before the natural balance of the circulation is fully restored. In such a case, the hands, feet, and nose remain chilly, and also cold to the touch of another person. The fingers, lips, and indeed the whole face, has a bluish tint, and a more or less shrunken appearance. The pulse continues weak and slow, and languor and feebleness characterize all the movements. Of course, the method of

deriving the greatest amount of benefit from these indications is for each person to cautiously test the power of his system to establish reaction, commencing with a bath of  $70^{\circ}$  or  $65^{\circ}$ , and gradually descending the scale of the thermometer, as he finds he is able to fully react from the depression produced by venturing among its lower depths. It is recommended by some authors to resort to cold bathing either about an hour before breakfast in the early morning, or else late in the evening just before retiring for the night. The early morning bath of this kind may do very well for some few people of unusually vigorous constitutions, but as a general rule the evening is a better time for such a test of strength; and for many persons the middle of the morning, that is to say, about three hours after breakfast, when the first meal of the day has been nearly all digested, and the system is fortified thereby to bear the shock and establish the necessary reaction after it, is decidedly preferable to any other period of the twenty-four hours. Under no circumstances should a cold bath be indulged in either immediately before or immediately after a meal, on account of the tendency which its inevitable shock will have to produce more or less disturbance in the process of digestion by congesting the stomach and intestines. Nor are cold baths suitable for individuals in either extreme of life, because both in infancy and in old age the power of developing animal heat is least efficient in its operations, and the reaction is accomplished slowly or not at all.

Protracted labor or exercise, whether mental or physical, if so long continued as to leave the body suffering from feelings of great weariness or exhaustion, absolutely forbid the use of the cold bath. It was under these circumstances that Alexander the Great, of Macedon, nearly perished, from plunging after a long and fatiguing march into the icy current of the river Cydnus; an imprudence which, it is said, did actually prove fatal to the German emperor, the aged Frederick Barbarossa, at the head of his crusading army, seventeen hundred years later. In adverting to this latter event an ancient author quaintly observes: "No wonder if the cold water quickly quenched those few sparks of heat left in him at seventy years of age." As a full comprehension of the good and evil effects of cold bathing, according to the amount of previous exercise, excitement, and fatigue, is very important to every one, an abridged account given by the celebrated Dr. Currie, in relation to his own personal experience with this agency, may be here inserted with advantage. On the first of September, 1778, two students of medicine at Edinburgh set out on foot on a journey, a considerable part of which lay along one of the rivers of Scotland. They started by sunrise, and proceeded with alacrity in the cool of the morning. At the end of eight miles they breakfasted, rested for an hour, and then resumed their journey. The day grew warm as it advanced, and after a march of eight miles more they arrived, heated but not fatigued, on the banks of the river above mentioned, about eleven



in the forenoon. Urged by the fervor of the day, and tempted by the beauty of the stream, they stripped instantly and threw themselves into the river. The utmost refreshment followed, and, when they retired to the neighboring inn, this was succeeded by a disposition to sleep, which they indulged. In the afternoon they proceeded, and travelling sixteen miles further at a single stretch, arrived at the inn where they were to sleep a little after sunset. The afternoon had been warm, and they sweated profusely; but the evening was temperate and rather cool. They had travelled for some miles slowly, and arrived at the end of their journey stiffened and weary with their exercise. The refreshment which they had experienced in the morning from bathing induced, however, one of them to repeat the experiment, and he went perfectly cool into the same river, expecting to relax his limbs in the water, and afterwards to enjoy profound sleep. The consequences were very different. The Tweed, which was so refreshing in the morning, now felt extremely cold; and he left the water hastily. No genial glow succeeded, but a feverish chill remained for some time, with small, frequent pulse, and flying pains over the body. Warm liquids and friction brought on at length considerable heat, and towards morning perspiration and sleep followed. Next day, about noon, they proceeded on foot; but the traveller who had bathed was extremely feeble; and though they had to perform a journey of a single stage only, as some parts of it were difficult and mountainous, he was obliged to take the assistance of a carriage which overtook them on the road. It was several days before he recovered his usual vigor.

The duration of a cool or cold bath must vary, very much with the temperature of the water. When very cold the period of immersion should not exceed one or two minutes, whilst with water between sixty and seventy degrees, the duration of the bath may extend to a quarter or even half an hour; in every instance, however, we must be guided by the completeness of the reaction on coming out of the water. Energetic friction of the whole surface of the body after bathing is highly beneficial as tending to produce the necessary degree of reaction. Active physical exercise, as well as warm and stimulating drinks, likewise aid in accomplishing the same desirable result. Even when a person is accustomed to the daily use of the cold bath, any sudden reduction of strength, such as may result from intemperance in eating, an evening debauch, or excess of any kind, particularly of the sexual powers, or even over-exertion in walking or in field-sports, will forbid recourse to it the following morning.

Bathing in rivers is even more to be recommended than that in ordinary bath-rooms during the summer season, as the gentle exercise of walking to and from the river-side, and of swimming whilst immersed in the water, promote the reaction which is so conducive to health. Evil consequences are, however, apt to result from river-bathing, if the baths are too prolonged, if too violent exertion is indulged in, or if the rays of

the sun overheat the head of the bather. Dr. Bell states that he has seen continued fever, of some days duration, and violent headache, with slight delirium, arise in boys who had thus imprudently exposed themselves.

### Varieties of Cold Baths.

There are various ways of employing water in cold bathing, according to the force of the current of fluid, the amount of surface to which it is applied, and so forth. Affusion and sponging are the mildest ways of using cold water as a bath, and there are few persons, not actually invalids, who cannot thus employ water, of moderately low temperature, with benefit. After the slight depression of the bodily warmth, produced by sponging with fluid of sixty or sixty-five degrees, of course but a mild reaction follows, but this is suitably proportioned to the feeble energies of debilitated persons. By a repetition of the process a greater endurance is developed, and colder water may ultimately be resorted to, with correspondingly increased advantage. The cool or cold sponge-bath is sometimes of great service in treating typhoid fever, and others of the eruptive diseases, as will be explained in the second part of this work. In a shower-bath the water falls in divided streams, and thus, being generally distributed over the whole body, gives a severe shock to the system; such a one, should the fluid be of a low temperature, as only the most vigorous persons can endure. The cold douche differs from the shower-bath in that the water of a douche is poured upon the surface of the body in a solid column, instead of a number of small streams. It is sometimes highly efficacious in reducing the violent excitement of delirious or insane patients, but, being a very powerful agent, should be used only with caution and close watching, never in the indiscriminate way customary in some so called hydropathic establishments, from which it is said that more than one sudden death has been the lamentable result.

The advance into old age of those who, in the vigor of youth and maturity, have accustomed themselves to the regular use of the cold bath, does not necessarily interpose an obstacle to the continuance of the practice of bathing, provided the general health remains good. But if there be evidence of feebleness of the functions, or disorder in any one of the great systems of the body, such as the digestive apparatus, or the muscular system, so as to prevent the customary allowance of nutritious food, or of exercise being taken, the cold plunge or shower bath should be given up, and simple washing with cool water, followed by active friction, substituted in its place. Should even this prove rather too great a shock for the enfeebled powers of life, as may be evinced by want of prompt reaction subsequently, recourse to anything but the tepid or warm bath must be strictly prohibited.

The evidence in favor of great benefit being derived in suitable cases from the so called water-cure, in the numerous hydropathic establishments



of Europe and this country, is very convincing; and, in fact, it is probable that persons generally of great mobility of temperament, who are readily excited and readily depressed, and whose nervous system is soon exhausted by either bodily or mental efforts, will often find relief in the systematic use of a moderately cool or cold bath. The difficulty is with establishments of this kind that, being carried on as business enterprises, their proprietors are not withheld, by any philanthropic considerations, from looking at every case which applies to them with an eye to business, and recommending their particular cure to all possible patients, except where they are very sure that positive injury will result from the treatment. It is therefore advisable, in every instance, to consult some reputable physician, who is not devoted to any exclusive system or dogma of medical practice, before submitting oneself to the powerful agencies of water as applied by hydro-pathic practitioners. Dr. Bell judiciously remarks that there is a class of people, who suffer from a sedentary life, devotion to the desk in business, or to study, and complain of a troublesome heat and dryness of the hands, and sometimes of the feet, with accelerated pulse and thirst; their appetite is not good, nor their sleep sound or refreshing. Though their systems be actually weaker than usual, yet is there morbid activity of the skin, owing, in part, to the vessels of the integument not relieving themselves by free and regular perspiration. Cold bathing, by moderating cutaneous excitement, and relieving the perspiratory organs, removes the unpleasant feeling of heat and dryness; and, by sympathy, produces nearly correspondent effects on the stomach. The use of the flesh-brush and exercise in the open air are, it may be supposed, powerful auxiliaries to the measures just recommended. There are many persons who, though enjoying what is often called full health, are liable to colds, rheumatic pains, and stitches from any slight exposure to cold or moist air. Their vascular and nervous systems are both tolerably excitable, and they are readily thrown into perspiration from even moderate exercise or warm apartments. In them it is desirable so far to regulate the functions of the skin, as to moderate its stimulation, and prevent the consequent debility which follows this state. Cold bathing accomplishes this purpose, and keeps the skin in a less constant condition of excitement, renders it less liable to sweat so freely from exposure to external warmth or by active exercise, and, of course, prevents the subsequent languor and susceptibility to morbid and enfeebling agencies. It would be a great mistake, in such a case, to talk of the tonic action of cold bathing. Its beneficial operation is evinced here at a time when no stimulus or tonic is admissible, and in habits sanguine and plethoric, on which nearly similar effects with those from cold bathing would be produced by a moderate bleeding, reduction of the usual quantity of food and diluent drinks.



### Hygienic Application of Warm Baths.

When the water used for bathing has a temperature of from 92° to 98° Fahrenheit, it produces upon the skins of most people the sensation of warmth, and although water of this degree of heat is usually employed chiefly for cleansing purposes, yet it has hygienic properties of a sufficiently marked character to render it worthy of especial notice. Since water is a much better conductor of heat than air, and especially than confined air, as much caloric is extracted from the human body when immersed in water which is only a few degrees lower than the average human temperature, as by air of much greater relative coldness. The warm bath diminishes the frequency of the pulse, especially when it has been greater than natural; and this effect is almost exactly in proportion to the duration of immersion. It also renders the respiration slower, and diminishes the temperature of the body, relaxes the muscular fibre, increases the bulk of the fluids by absorption, or perhaps only by restricting evaporation from the skin, removes impurities from the surface, promotes desquamation and renewal of the cuticle, lessening the hardness of the nails and indurations of the epidermis. The separation of the outer layers of the scarf-skin or epidermis, which may often be seen floating in small whitish fragments upon the bath water, is due to two causes. In the first place it is softened by the water, and so rendered more easily removable by slight friction; and secondly, it is in part pushed off by the increased fullness of the blood-vessels underneath. A humorous writer has compared the epidermis which covers the whole surface of the body to a tight shirt, and a dirty cuticle, therefore, to a dirty shirt which is gotten rid of by the aid of a bath. A prolonged daily use of the warm bath is apt to cause eruptions on the skin similar to those which managers of water-cure establishments pronounce critical, and of the greatest advantage in certain diseases of the nervous system. An immediate and very agreeable effect of the warm bath is to soothe a nervously excited condition and promote sleep, which to many people is peculiarly refreshing when procured by this means. The best period for taking a warm bath is about an hour previous to the mid-day meal, because then the disturbance of the circulation will have time to pass off before food is introduced into the stomach, and the secretion of the gastric juice and other fluids necessary for digestion will not be thereby interfered with. The duration of a warm bath ought not to exceed in ordinary cases half an hour, although in the warm water-cure of Leuk, in Switzerland, patients sometimes remain in the tepid fluid five hours in the morning and three hours in the afternoon, with alleged benefit. In the Leuk baths, persons breakfast from little floating tables, which afterwards serve to support books and newspapers for their amusement, and it is said that the Emperor Charlemagne used to hold prolonged levees whilst immersed

in his warm bath at Aix-la-Chapelle, which was supplied by one of the numerous thermal springs of that famous city. The relaxing and soothing influence of the warm bath is an invaluable aid to the treatment of many acute diseases, and being, as a general rule, devoid of danger in its application, is a remedy peculiarly adapted to domestic practice, particularly among children, before the skilled physician, who should always be sent for immediately when a person is attacked with any acute disease, has time to arrive. Its prompt remedial effects may often be observed in bilious colic, in painters' colic induced by the poisonous influence of lead, in spasmodic croup, in infantile convulsions, in mental excitement bordering on delirium or even violent maniacal frenzy, and in many other diseases, as will be more fully explained in the second part of this book.

### Hot Baths.

The hot bath is so designated if the water employed is above the natural blood-heat of about  $98^{\circ}$  Fahrenheit, and may range as high as  $110^{\circ}$ , above which it is seldom safe to use water over the whole surface of the body. Of course, habit will often enable a person to endure the local application of water having a much higher temperature than this without injury. Hot baths are decidedly stimulating, and rapidly produce redness of the skin with quickening of the pulse and respiration. Perspiration is poured out upon the face in great abundance, the mind becomes dull and inattentive, and, if the immersion is unduly prolonged, vertigo and apoplexy may supervene. One experimenter lost, during the short space of eight minutes, in a bath of the temperature of  $113^{\circ}$ , about a pound and a half of his weight. Even a hot foot-bath of  $110^{\circ}$  is stated in one case to have quickened the pulse from seventy-seven to ninety-two, and to have caused some headache in about half an hour. In another instance a foot-bath of  $113^{\circ}$  raised the pulse from sixty to one hundred and five beats per minute in five minutes, and flushed the face, but without bringing on headache. The hot bath ought therefore to be employed cautiously or not at all by persons of sanguine temperament, and those of robust or plethoric habit of body, especially if there is any hereditary tendency to apoplexy in their families. This powerful remedy is, however, capable of doing good service in conditions of torpid, sluggish circulation, dry and cold skin, feebleness of muscular movement, and a low grade of sensibility; but great care must be used not to mistake this state of the system in an individual naturally weak and phlegmatic, or enfeebled by old age or chronic disease, for the languor of the vital processes which is produced by acute inflammation, or pressure of the blood upon the brain or upon the lungs. In suspended animation from sunstroke, apoplexy, insensibility from inhaling noxious gases, or from swallowing narcotic poisons, disastrous results might be, and probably would be, produced by the application of a hot bath. In exhaustion and

torpor from exposure to intense cold, the hot bath, contrary to popular opinion on the subject, is a most valuable remedy. Some recent experiments performed in Russia, in order to determine what is the best way to resuscitate animals which have been subjected to such severe cold as to be almost fatal in its effects, gave the following results: Of twenty dogs treated by the customary gradual method of bringing them into a cold room which was slowly warmed, fourteen died; of twenty similar animals introduced at once into a warm room, only eight died: whilst of twenty in an analogous condition, which were placed at once in a hot bath, *all recovered*. Hot baths applied locally to small portions of the body only have often proved beneficial in gout and in acute as well as chronic rheumatism, and are highly recommended by some authorities for the relief of piles, in certain affections of the kidneys, and in some female disorders.

Sundry modifications of the hot bath, such as the Turkish bath, the vapor bath, and so forth, have, under certain circumstances, considerable value.

#### **The Hygiene of Sea Bathing.**

The long line of seacoast belonging to the United States, and the large proportion of our population which resides within a day's journey of the ocean, by placing a salt bath within the reach of many readers, render the subject of sufficient importance to be separately discussed. On paying a visit to the seaside, it is well to refrain from bathing, and indeed from exposure to the rays of the sun on dry land also, for a day or two if possible after arrival, or until the system becomes a little accustomed to the effect of the salt air and the surroundings. The rules already given in regard to the time of bathing, and especially as to not entering the water for an hour or so before or after a meal, ought to be strictly adhered to. The time spent in the water cannot be prescribed with the same exactitude, since the proper length of a dip in the ocean varies very greatly with the temperature of the water and air, the vigor of the individual's constitution, his temporary condition of health, and so forth. But in the state of the circulation we fortunately have a general guide, which every one can readily consult for himself, and quickly determine when nature decides that the bath should promptly terminate. After the first shuddering inspiration, which is generally produced by the application of cold water to the bare surface of the body, with the quickened pulse and breathing which for a few moments accompany it, the pulse, the action of the heart, and the respiration all become slower for a short time, and then are again accelerated. But if immersion in the cold seawater is too long continued, the pulse and the breathing are again reduced in frequency, a sense of chilliness comes on, and with this a slight blueness of the lips, and of the fingers underneath the nails, makes its appearance. The moment this is perceived, it should be accepted as an imperative order to quit the water at once, and restore the lost activity of the circulation,



which it indicates, by energetic friction of the surface with warm, dry towels as speedily as possible. As a general rule, from five to fifteen minutes is amply sufficient time to spend in the surf, and it is far better to err on the prudent side by coming out needlessly soon, than to prolong the bath until the teeth begin to chatter and the fingers have the shrivelled, bluish-white appearance of a washerwoman's hand, thereby risking some serious internal congestion afterwards. When the water is unusually cold, and especially when the air is also chilly, a bath in the ocean, if taken at all, should be correspondingly brief. In order to obtain the best results, a bather should enter the water whilst he is comfortably warm, and yet not in a free state of perspiration. It is a good plan to wet the head and breast first, or after wading only a short distance from the edge, for the purpose of avoiding the temporary fullness of the brain, which leaves some persons with a dull headache for several hours; also, if the sun is shining brightly, a bathing hat, or other protection for the head and nape of the neck, ought always to be worn.

Floating, diving, and swimming are excellent ways of adding to the pleasure of the sea-bath, but the latter should not be indulged in when the surf is very heavy, when the tide is running out, or when there is a strong current nearly in a line with the margin of the beach, as the latter may diverge a little from the coast, and carry the bather too far out to sea before he is aware of his danger.

### **Bathing Accidents.**

A summer so seldom passes at the great seaside resorts without the sacrifice of one or more lives to the want of knowledge respecting the treatment of half-drowned persons, and its timely application, that a few suggestions seem to be called for here, in connection with remarks upon salt-water baths. When a person is seen struggling beyond his depth, the best plan is for a party of rescuers to form a line, holding each others' hands, so that the individual constituting the outer link may be drawn in by the others if grappled and endangered by the drowning man. In endeavoring singly to save an exhausted swimmer, beware of his death-grip, which is often fatal, and try to seize him from behind, by the hair or collar, and tow him to land. On arriving at the shore, if the person, when drawn out on the sand, makes no effort to breathe, lose no time in trying to secure shelter, warmth, stimulants, or even dry ground, but proceed at once, without a moment's delay, to practice artificial respiration, which should be continued faithfully for at least two hours, as even after that length of time without a sign of life, recovery has taken place. A good first rule is to instantly remove all obstructions to breathing, by loosening or cutting apart all neck or waist-bands; then turn the patient on his face with the head down hill, stand astride of his hips with your face towards his head, and locking your fingers together under his belly, raise the body

as high as you can without lifting the forehead off the ground, and while thus held give the body a smart jerk to expel, if possible, mucus from the throat and water from the windpipe. To facilitate this important preliminary, let an assistant at this moment pry open the mouth and pull out the tongue, seizing it by the aid of a dry handkerchief. The next



FIG. 8.

RESUSCITATION OF THE DROWNING.

step is immediately to turn the body over on its back, slip a rolled-up blanket, shawl, or coat under the shoulders, and proceed at once to imitate natural breathing. To do this let the operator grasp the arms of the patient just above the elbows, and draw them upwards until they nearly meet over the head (Fig. 8.) After pulling them upward forcibly, hold them in this position whilst you count slowly, one, two, and then bring them down to the sides again, and press, by means of the elbows, upon the lower part of the chest (Fig. 9), and the upper part of the belly immediately below the breast-bone, whilst you again count one, two. The former of these movements expands the chest, and draws some air into the patient's lungs. The latter motion, which is like shutting together the handles of a pair of bellows, compresses the chest and drives some of this air which has been sucked in out again, thus imitating the process of natural respiration. This alternate expansion and compression of the chest ought to be repeated about fifteen times per minute, and kept up for two or three hours. It is prob-



FIG. 9.

RESUSCITATION OF THE DROWNING.

ably far more successful in resuscitating those who are apparently drowned than at first sight appears; because some, perhaps many, of the people brought to shore under such

circumstances as have been described, are dead from heart-disease or from apoplexy, and are therefore hopeless subjects for treatment by artificial respiration.

### Medical Use of Sea-Bathing.

Scrofulous affections, including hip-disease, disease of the spine or of the joints, and enlargements or ulcerations of the lymphatic glands in the neck and other parts, are particularly apt to be benefited by salt-water

bathing, the favorable influence of the sea air and its contained ozone probably adding much to the beneficial effect experienced. In chronic pulmonary disease, and even pronounced consumption, patients often derive much advantage from sea-bathing, except when there is a tendency to spitting of blood, in which case the stimulating influence of salt air and salt water must be very guardedly encountered, and only under the advice of an experienced physician. Dyspepsia, diseases of the kidneys and bladder, nervous complaints, and the curious affection called "rose cold" or "hay asthma," all yield very promptly, in some instances, to the influence of ocean air and baths.

As a general rule, a person with any acute disease ought not to bathe in the surf without the explicit sanction of his physician, and the same may be said in regard to organic affections of the heart, and advanced pulmonary maladies. Among females menstruation is, of course, a complete bar to sea-bathing, but if the general health is fairly good, pregnancy, at least up to the seventh month, does not render it more dangerous. For individuals of feeble constitution, those who visit the seashore to recuperate after being mentally or physically overworked, and for convalescents, warm salt-baths for a few days, and then daily sponging in their rooms with sea-water, are valuable preliminaries to exposure in the full force of the surf.

#### **Mineral Waters in Health and Disease.**

The subject of mineral waters, especially in America, where almost every State in our Union can boast of springs and watering-places, is very extensive, and would require a separate treatise for its appropriate consideration. In the present section, only a few of the most important varieties of mineral waters which this country affords can be considered. There is no doubt that many persons entertain a highly exaggerated idea of the value of mineral waters, attributing to them almost all the miraculous healing powers of the pool of Bethesda or those which Naaman found in the river Jordan. But, on the other hand, those skeptical individuals who sneeringly assign all the manifest improvement which we frequently observe during visits to watering-places, to the effects of the imagination, to the changes brought about by travelling, new and pleasant scenes, regular hours, and relaxation from the toils of labor or the cares of business, are probably quite as much in error. Chemical analysis has proved that some of the far-famed mineral waters of both the Old and the New World contain certain of the most powerful mineral remedies found in nature, and practical experience long ago demonstrated that these medicines, as they exist in the natural mineral waters, often produce the same effects as those dispensed from the apothecary shops, with more ease, less disturbance, and occasionally in a perfectly painless manner. The theory which attributes the benefits of a visit to the springs to the influence of the imagination, seems to be disproved by the facts, according to



Dr. John Bell, that "animals, such as horses and cattle, dogs, and even the literal swine, have been evidently cured of obstinate maladies by this means," without our being able to divide the credit with any other influence.

According to Dr. Bell, author of an excellent little book upon the subject, the mineral springs of the United States and Canada may be conveniently arranged in four classes, as follows: 1st. The acidulous or carbonated. 2d. Saline. 3d. Sulphurous. 4th. Chalybeate. To these some add two other groups, namely, the ioduretted and bromuretted, and the acid. The name of the first of these two designates their predominant traits. The second, or acid, includes those waters, comparatively few in number, in which there is an excess of sulphuric acid, usually with alumina and iron, as sulphates. In Virginia they are called alum springs. Acidulous waters are sometimes called gaseous, on account of their containing and evolving gas, which is chiefly carbonic acid. Owing to this ingredient, they are sparkling, stimulant, agreeable, and pungent to the taste. They hold in solution various saline substances, in which, for the most part, the carbonates—first and mainly of lime and then of magnesia and soda—predominate, with the addition, often, of the carbonate of iron and chloride of sodium or common salt. These waters are occasionally spoken of as alkaline.

Saline waters, as their name implies, abound in salts, of which the sulphate of magnesia or Epsom salts, and the sulphate of soda or Glauber's salts, are medicinally the most active, while chloride of sodium, a usual constituent, adds to their virtues in this respect. Sulphate of lime, which is of little therapeutical value, is quite common.

In this, and still more in the acidulous and sulphurous classes, carbonic acid abounds in some of the saline waters, entitling them to be called acidulo-saline. A remarkable example of this union is met with in the Saratoga Springs.

1 Sulphurous waters are characterized by their odor, which is due to the escape of sulphuretted hydrogen gas, hydrosulphuric or sulphohydric acid, or to the presence of an alkaline sulphuret. They strike a black color on the addition of acetate of lead, and impart a dark hue to silver coins, trinkets, or utensils. They have been divided into: 1st. Hydrosulphurous waters, which contain free sulphuretted hydrogen gas. 2d. Sulphuretted or hydrosulphuretted waters, in which the sulphur is combined with metals, most generally with sodium, in the state of a sulphuret. 3d. Acidulo-sulphurous, which hold carbonic acid in addition to the gas just named. 4. Sulphuretted acidulous waters, which contain at the same time a sulphuret, carbonic acid, and sulphuretted hydrogen gas. 5. Chalybeate sulphurous, which hold iron in solution.

Chalybeate or ferruginous waters are readily recognizable by their taste, compared usually to that of ink, which, as most readers know, depends

on the iron which enters into its composition in union with a vegetable astringent. Chalybeate waters are discolored by tincture of galls, and eventually give, by this addition, a black precipitate; with ferrocyanate of potassa, the precipitate is blue; by contact with the air, they deposit gradually reddish flocculi of the oxide of iron. Most of them are cold, and the iron is in the state of a carbonate of protoxide dissolved in carbonic acid. This salt is precipitated to a certain extent by exposure of the chalybeate water to the air, and still more readily when it is subjected to heat. In a few instances the iron is combined in the form of a sulphate, and in others, as Berzelius has shown, it unites with an organic acid, in the state of a crenate or a procrenate.

Another division of mineral springs is into cold and thermal, each one of which is applicable to all of the four great classes, for we have cold and thermal acidulous, cold and thermal saline, and so on.

As suggested by Bischof, the term thermal is used to designate any spring, the temperature of which throughout the year is steadily above that of the common springs, or above the mean temperature of the soil of the district in which it is found.

The variety of diseases for which these different mineral waters have been recommended is very great; but the number of maladies in which a reasonable hope of benefit can be entertained is comparatively small. Affections which are often found to be curable by the use of mineral waters, comprise certain forms of disturbance of the digestive apparatus, others of the cutaneous and fibrous system, under the latter being classified gout and rheumatism; sundry disorders of the glands, both secretory and lymphatic; and lastly, derangements of the nervous system of particular varieties. Under the first head comes dyspepsia in all its protean aspects, including affections of the throat, of the stomach, of the small intestine, and of the large intestine. This class also includes chronic diarrhoea and dysentery, constipation, and hemorrhoids or piles. A great variety of chronic eruptions of the skin are grouped under the second head, many of these disorders being the results of long-standing maladies, such as syphilis or venereal disease, scrofula, scurvy, and so forth. In the second class, too, the most important are rheumatism and gout, with their numerous and dangerous secondary derangements of the heart, the brain, the kidneys, and the digestive apparatus. Diseases of the glands, especially those of a scrofulous character, uterine diseases and diseases of the spleen, making up the third class, are often found to be benefited, and complaints of the nervous apparatus, whether exhibiting a morbid sensibility with irregular spasmodic and convulsive movements, or on the other hand of loss of sensibility and paralysis, are both considered fitting subjects for the use of mineral waters, internally and by bathing; for, in order to insure all the benefit which can possibly be derived in cases of disturbance of the nervous system, both of these methods of application ought to be employed.



From a report on the efficacy of the mineral springs of France, made by a Committee of the French Academy, we learn that formerly invalids suffering from only a few diseases sought the benefit of these waters. Among these maladies were, first, rheumatism in all its forms, the subjects of which made up nearly one-third of all the invalid visitors. This class were met with at some springs in the proportion of one-half or even two-thirds of the entire number. Next in frequency appeared those suffering from nervousness or nervous derangements with augmented sensibility, often with spasmodic affections of the digestive and other systems. Holding a third place were chronic inflammations of the mucous and serous membranes, a large class comprehending diseases of the digestive and respiratory organs, and of the uterine and urinary apparatus, and neuralgias of the internal viscera; at some springs, paralysis and diseases of the skin, constituting as it were a specialty, present themselves; after which, in a fifth group, appear old wounds, false anchyloses or stiffening of the joints, and lymphatic enlargements. Beyond these five classes the Committee asserted that they only met with a few other cases of disease at mineral springs. In regard to the relative curative powers of the mineral waters in these various maladies, they were represented to be quite certain in rheumatism, tolerably sure for neuralgias and other affections of the nervous system, not unfrequently useful in diseases of the skin and of the joints, and almost useless in paralysis. It is highly probable, however, that this claim of the curative power of mineral spring water in chronic rheumatism is much exaggerated, especially as we hear of the same invalids returning year after year, to drink and bathe in their favorite mineral water, as a remedy for troublesome rheumatic and gouty complaints.

The best known mineral springs of the United States are doubtless those of Saratoga and Ballston, in Eastern New York. Among them the water from the celebrated Congress spring is especially noted. It contains, according to one of the most reliable analyses, about seventy-five grains of saline ingredients in the pint of water. These solid materials comprise about forty-eight grains of chloride of sodium or common salt, twelve grains each of carbonate of lime and of bicarbonate of magnesia, a small amount of bicarbonate of soda, and minute quantities of iodine, bromine, and iron in combination. The most important gaseous element is carbonic acid, which exists in the large amount of thirty-nine cubic inches to the pint of fluid. The diseases in which Saratoga water has proved especially useful are dyspepsia, liver complaints, piles, chronic rheumatism, chronic bronchitis, and also in chronic gout. The first white visitor to the Saratoga Springs was Sir William Johnson, in 1767. He was very subject to the gout, and his health was improved by the use of the water from High Rock spring. This was the first spring to which the attention of the colonists of that day was directed by the Indians, in



whose traditions it had long been celebrated for its medicinal virtues, especially for the cure of rheumatism. The water should be drunk at the springs, in quantities of from one to three pints, early in the morning, before breakfast. It ought to be swallowed in draughts of about half a pint each, at intervals of from five to ten minutes, the invalid walking about or taking other exercise during the whole period. After free purging is in this way produced, improvement may often be best promoted by a subsequent alterative employment of the water in small doses, of perhaps half a pint daily, or by a tonic course of certain other spring waters, in which iron and iodine are more abundant.

The most famous sulphur springs in the Northern States are those of Sharon, also situated in New York. They have been compared to those of Aix-la-Chapelle, in France, where the Emperor Charlemagne sought relief in the eighth century, and the well-proved medicinal virtues of which still bring to that city thousands of strangers every year. The water of the White Sulphur Spring, at Sharon, contains about seven grains of sulphate of lime and two and a half of sulphate of magnesia, with small quantities of chlorides and sulphides, and one cubic inch of sulphuretted hydrogen to the pint. Its efficacy is said to be particularly great in rheumatism, gout, and paralysis, also in stiff joints and gun-shot wounds. It is likewise highly recommended in chronic laryngitis and pharyngitis, liver complaint, and neuralgia; and, among external affections, for those obstinate diseases of the skin, psoriasis, eczema, and lichen.

As an example of the acidulous springs may be mentioned the Rock-bridge alum springs, of Virginia. According to a recent analysis, one of the strongest of these waters contained about eighty-one grains of sulphate of alumina, nine grains of sulphate of magnesia, six of sulphate of copper, and five and a half of sulphate of iron, besides ten cubic inches of carbonic acid per gallon of liquid. These waters are highly recommended in consumption and scrofula, in chronic derangements of the stomach, liver, and bowels, in diabetes, gout, diseases of females, and in skin diseases, especially those of a vesicular or pustular character.

The springs of our far West have not yet been sufficiently tested to enable us to decide positively as to their merits, but no doubt they will ultimately prove of great value. The highly-praised spring of Waukesha, Wisconsin, has already acquired no inconsiderable reputation in the treatment of Brights' disease. The carbonated waters of Manitou, Colorado, have been shown, by recent analyses, to contain lithia, an element supposed to contribute largely to the beneficial effects of the Vichy water in gout and rheumatism, and the hot sulphur springs of California and New Mexico have a local repute, which renders a full scientific investigation of the medicinal properties eminently desirable.

## CHAPTER II.

# PURE AIR AS A CONDITION OF HEALTH.

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### The Vital Necessity of Air.

For all land animals, and especially for human beings, a sufficient supply of pure air is the most important condition of life, as any one may demonstrate by attempting to hold his breath for even a single minute. It is true that some persons, with strong wills and capacious lungs, can readily perform this feat, but if they endeavor to prolong the experiment for a minute and a half or two minutes, the need for breathing becomes so intense that control over the muscles of the chest is lost, and a deep inspiration must be drawn, in spite of the most dogged resolution to the contrary. If the access of fresh air to the lungs is absolutely prevented by external force, death speedily takes place, the fatal result occurring, as is shown by various human contrivances from a mouse-trap to a hangman's noose, in from five to fifteen minutes. Or if a partial, but insufficient, supply of air is permitted to enter the lungs, one of the most painful forms of dying such as we often behold, unfortunately, in children who are the victims of croup, namely, that by slow suffocation, is produced.

But it is not enough that air is supplied in adequate quantity in order that life shall be sustained and health preserved even to a moderate extent. The air which we breath must be sufficiently rich in that great life-giving element of nature, oxygen gas, and sufficiently free from the many poisonous or injurious ingredients which it frequently has mingled with it, or else health is soon sacrificed and long life is out of the question.

No better illustration of the fatal effects of impure air upon the human system can be brought forward than the lamentable history of the Black Hole of Calcutta, a prison in India, the horrors of which have rendered it memorable even in that land of ferocious cruelty. According to the account of a survivor, 146 persons were shut up, on a sultry night of June, in a prison not quite eighteen feet square, furnished with only two small windows, both strongly barred with iron. The thirst and oppression of breathing felt by the unhappy prisoners soon became intense, and the scanty supply of water brought in compliance with their entreaties,

only made the confusion more terrible, and caused several to be trampled to death. This scene of misery proved entertaining to the brutal guards outside, who supplied them with water that they might have the satisfaction of seeing them fight for it, as they phrased it, and held up lights to the bars in order that they might lose no part of the inhuman diversion. Before eleven o'clock most of the gentlemen, who formed about one-third of the whole, were dead, and "air! air!" became the general cry. Renewed insults were devised for the purpose of provoking the guards to shoot them, and every man had eager hopes of meeting the first bullet. About two o'clock in the morning, the survivors crowded so much to the windows that many of them died standing, unable to fall on account of the throng. About six in the morning, an order came for their release; but at that time, out of the 146 who went into the dungeon ten hours before, only twenty-three remained alive, and all these miserable survivors were in a highly feverish condition, several dying from putrid or typhus fever soon afterward. Such, then, are the frightful consequences of overcrowding together a large number of human beings, and thus depriving them of fresh air in such a way that they are exposed to the poisons of their own contamination, comprising carbonic acid and the secretions from the lungs and skin.

Wholesale poisonings by very impure air of this kind are fortunately seldom met with, but the gradual injury to health and destruction of life-force, produced by breathing an atmosphere slightly contaminated with noxious ingredients, are exceedingly common, and probably give rise to or aggravate a large part of the diseases to which our flesh is heir. Among those maladies to which foul air especially predisposes, the most dangerous is pulmonary consumption, as will be pointed out in a future chapter.

### Qualities of Pure Air.

The purest air is generally to be found in elevated regions, and at great distances from human habitations. When such air is carefully analysed, it is found to be composed of about seventy-nine parts in the hundred of nitrogen, and the remainder, that is, about twenty-one parts, of active vivifying oxygen. As ordinarily met with at the surface of the earth, our atmosphere contains a considerable quantity of watery vapor, a trace of ammonia, and from three to six parts in the ten-thousand of that deleterious gas, carbonic acid. In badly ventilated houses or barns, inhabited by men or animals, the amount of oxygen may be diminished down to twenty or even down to nineteen parts in the hundred, and the quantity of carbonic acid so enormously increased as to reach one or even two per cent., which would, of course, be equivalent to two hundred parts in the ten thousand. When such a great change in the constitution of the air we have to breathe occurs, it causes the fatal results of the "Black Hole of Calcutta," and even in much lesser degrees it has a powerfully injurious

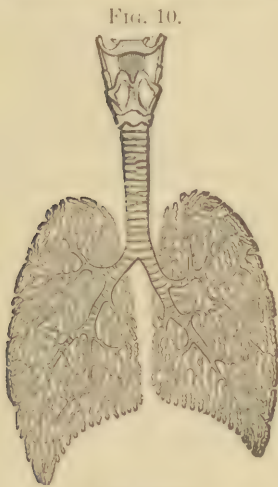


effect upon animal life, often strongly predisposing to attacks of disease, even where it is not itself the direct cause of illness.

In order to fully understand how it is that breathing in and out the air of a room or house into the lungs of a human being or animal, for any considerable length of time, vitiates it, it will be necessary to explain some points connected with the structure of the pulmonary organs themselves, and with the process of respiration.

### The Lungs.

The lungs are two in number, one situated on each side of the chest, or thorax, as it is called, the cavity of which they fill up, with the exception



of the space occupied by the heart and its great blood-vessels. They are surrounded and protected by a sort of bony cage made up of the twenty-four ribs, which are fastened in such a way to the backbone or spine, as to allow of their motion outwards, and the consequent expansion of the lungs. The great office of the lungs is to furnish oxygen from the air to the blood, where it is taken up by the red globules or corpuscles, and carried to all parts of the body.

The older physiologists rather fancifully described the life of man as enthroned upon a tripod or three-legged stool, one of the legs of which was the heart, the second the lungs, and the third the brain. If any of these legs gave way and failed to do its share in supporting the vitality of the system, the tripod of life was, as the ancients very truly believed, upset, active existence quickly came to an end, and death took place.

The inlet to the lungs is by the glottis, which opens just behind the root of the tongue, where it is covered by that curious trap-door, the epiglottis. From the glottis leads the windpipe or trachea, which, descending in the middle of the front of the neck as a tube about the size of the forefinger, divides into two (see Fig. 10), about opposite the centre of the breast-bone, and sends a branch, named a bronchus, to each lung. The trachea and its bronchial tubes may be well compared to a hollow tree, with its large limbs dividing into smaller branches, and these branches subdividing into twigs. But instead of leaves, we must imagine, in order to carry out the analogy, that each of these twigs bears upon its end a little bag of fine, thin membrane, or skin, called an air-vesicle. These delicate little bags, the air-vesicles, are so small that the lungs of an average sized man contain about six hundred millions, and a good idea can be formed of the extreme minuteness of

the finest blood-vessels, called capillaries, in the human body, if we remember that each of these tiny bags is covered with a network of capillary blood-vessels, through which a constant circulation of blood goes on.

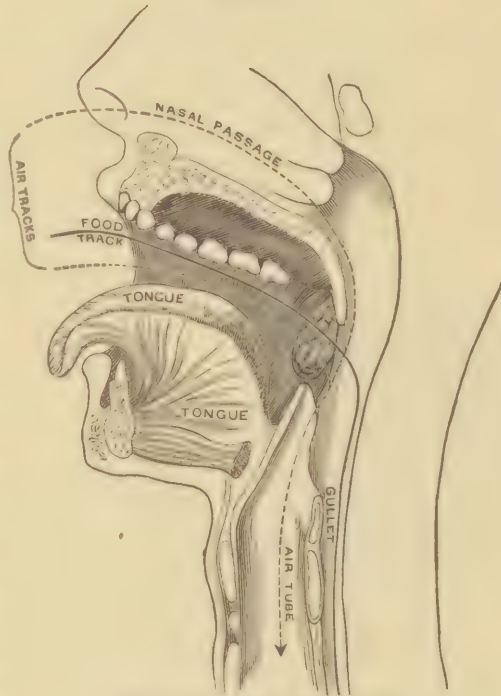
The air-vesicles are about one one-hundredth of an inch in diameter, so that they would each nearly contain a grain of coarse sand, such as is found on the seashore. They can therefore readily be seen with the ordinary eyesight. The trachea and bronchial tubes are lined with a soft, moist, red skin, called mucous membrane, similar to that covering the inside of the mouth and throat, except that the outer layer of the cellular elements with which it is built is ciliated, that is to say, the cells which compose it are covered with very fine hairs, which are in constant motion, waving backward and forward like a field of grain in the wind. Thus they serve to carry along the mucus which is all the time secreted, together with the little particles of dust which are drawn into the lungs in greater or less quantity with every breath. As the current produced by the motion of these cilia is always upward toward the glottis, when the materials

carried along can be coughed out and so gotten rid of, these industrious little ciliated epithelial cells do a very important work as street-sweepers on a small scale of the air-passages in the lungs. Hence, as will be explained later on, it is very important that their activity should not be interfered with by certain medicines, such as opium, when they are over-worked at any rate, as usually happens in a severe attack of bronchitis, for example.

### The Heart and the Pulmonary Circulation.

The right side of the heart, which has for its business the pumping of the blood through the lungs, that is, through the pulmonary circulation, as it is called, sends it along through tubes which ultimately divide into very delicate blood-vessels, named capillaries, which are spread out in a

FIG. 11.



THE AIR-PASSAGES OF THE LUNGS.

fine network of meshes, just like those of a fishing-net, except that they are made with hollow pipes instead of with strings, upon the surface of each pulmonary air-vesicle. By this means all the blood is exposed to the action of the air in the lungs without anything between the two fluids but an exceedingly thin membrane—the substance or wall of the capillaries—which is very far thinner than the finest paper that ever was made. In this highly ingenious manner the blood is placed in the most favorable position for being purified and ventilated, so to speak, by losing its injurious gases and taking up a new supply of life-giving oxygen. Each lung is wrapped up in a sort of double bag, called the pleura, the surfaces of which, when they come in contact, are kept moist by their own secretion, in such a way that no friction or other interference with the proper expansion of the lung occurs. The painful disease called pleurisy, which is an inflammation of the pleura, is generally brought on by taking cold, and on this account it is very important to guard oneself against being exposed to cold or damp air when thinly clad about the chest.

As already hinted, one of the most common impurities of air is the gas called carbonic acid, the “choke-damp” of miners, which seems to have in some important respects exactly opposite properties to those of oxygen, in that it extinguishes flame which oxygen renders brighter, and produces death in animals for which oxygen supports life. The most usual source of carbonic acid in confined air is the combustion of carbon in our fires or lights, and in the breath of people shut up in crowded apartments. Any one can see for himself that there is a large amount of carbonic acid in the air which is breathed out or expired from human lungs, by the following little experiment: Make a specimen of lime-water by shaking a lump of unslaked lime the size of a walnut in a quart of water for five minutes; let it stand in the bottle over night to settle clear, and having poured out a tumblerful, breathe into it through a glass tube or large straw pushed down to the bottom of the goblet. As the air thus expired bubbles up through the lime-water, you will see this fluid grow cloudy, and in a minute or two turn almost as white as a city-milkman’s milk, from the formation of chalk or carbonate of lime, by the union of the lime in the lime-water with the carbonic acid of your breath.

The bright red arterial blood, as it goes out of the left side of the heart, is rich in oxygen, which is united, in the various organs and structures of the body, as it circulates through them, with the carbon of their worn-out portions, so as to form carbonic acid by the oxidation. This union of oxygen and carbon is really a process of slow burning, just as much a burning or combustion as that of the carbon in a lighted candle, which is oxidized into carbonic acid with the evolution of light and heat, only that the burning is so very much slower, that heat without any light is produced. This slow burning, called by physiologists *cremacausis*, is the chief source of the animal heat of our bodies, this heat in different



parts of the system being regulated and distributed by the flow of blood, which has been warmed in millions of little stoves, as it were, situated wherever cremacausis is going on, and each doing its infinitesimal share, with a truly generous public spirit, toward warming up the entire body, under the general guidance of the nervous system.

In this oxidation, or slow burning of the used-up portions of our bodies, is discovered the source of that carbonic acid which, being brought back to the heart in the dark, purple blood of the veins, is pumped into the lungs, where, finding itself shut off from freedom by the extremely thin membrane which constitutes the walls of the capillaries, it makes a bold push for liberty, struggles through this delicate obstacle, and escapes into the air-vesicles of the lungs, whence it is breathed out, as our lime-water experiment proves, in a subsequent expiration. In the mean time, an opposite fate has befallen some of the oxygen which has been inspired into the lungs. The little red blood corpuscles, which are so numerous in the vital fluid (see Fig. 25), seem to have such a powerful attraction for oxygen that they are able to coax it away from its free life in the open air to themselves, take it back a prisoner with them into the heart, and thence to the deepest recesses of the body. Thus carried along, whether it will or no, the imprisoned oxygen is put to work in the innumerable little stoves already referred to, and made to contribute its share to the animal heat by burning up some waste carbon, making thus a new quantity of carbonic acid, in which form it finds its way back to the lungs, and is at last liberated.

It may seem strange at first sight that, since men as well as animals have for many thousands of years been using up oxygen and throwing off from their lungs carbonic acid into the atmosphere, the air has not long since been rendered poisonous to us all. But the explanation of this phenomenon is that, according to one of the most beautiful evidences of design by an all-wise Providence, plants absorb carbonic acid and give out oxygen, so that our atmosphere is thus preserved pure, except where man, in his pitiful ignorance, shuts out the free air of heaven from his dwellings, and so renders of no effect such a wonderful provision for his own safety and comfort.

The lungs are expanded in inspiration by the contraction of the small, flat muscles between the ribs, which are so arranged as to expand the thorax, as is readily proved by putting a string or tape-measure around the chest, and then taking a long breath. Expansion of the lungs is also aided by the contraction of the diaphragm or midriff, which causes it to descend into the abdominal cavity.

Figure 12 exhibits an outline of the cavity of the chest as naturally

FIG. 12.

OUTLINE OF THE CHEST-  
CAVITY.

occupied by the lungs. At *e, e*, is shown the diaphragm in a relaxed condition, and at *i, i*, the same muscle strongly contracted, enlarging the capacity of the chest by the space indicated in white on the diagram.

As a necessary consequence of this increase in the capacity of the thorax, the air rushes through the windpipe and distends the lungs, just as it would through the nozzle of a pair of bellows if the handles were violently pulled apart. A knowledge of this little fact in anatomy explains why breathing is so very painful in that quite common disease, rheumatism of the muscles between the ribs, which is often mistaken for dangerous pleurisy or for inflammation of the lungs, and causes much though needless anxiety. (See article on Rheumatism in Part II.)

### **The Pulmonary Circulation.**

The heart, which is a thick, strong, muscular bag, pumps the blood through the lungs as it goes round and round through the circulation, at the rate of about sixteen hundred pints of the vital fluid every hour. These sixteen hundred pints of blood, by being spread out in the fine network of delicate tubes in the walls of the air-cells, get rid of nearly sixty pints of carbonic acid, and absorb rather more than sixty pints of oxygen in that length of time. Upon this gaining of fresh oxygen and getting rid of stale carbonic acid unceasingly, our very lives depend; for, as demonstrated in hanging and drowning, if this interchange of the gases in the blood is interrupted for even the space of a few minutes, death is the effect. Whilst life continues, night and day, our hearts must go on pumping dark, purple, venous blood into the lungs, to be there purified and changed into red arterial blood by losing its carbonic acid and gaining fresh oxygen, which is carried to every part of our bodies, as has been just explained, conveying everywhere its own new and vigorous life. Night and day, too, quite as unceasingly, must the lungs do their part, by pumping in fresh air to furnish this requisite supply of revivifying oxygen; and, what is almost equally important, they must pump out the air which has been partly deprived of its oxygen, and has received in its place the worn-out and now deleterious substances got rid of by venous blood, among which the carbonic acid and animal effluvia, such as proved fatal to so many of the poor creatures shut up in the Black Hole of Calcutta, are the most important and dangerous to human life.

### **Why Impure Air is Dangerous.**

Since, therefore, air which has once been breathed has lost some of its life-giving power, and what is far more worthy of notice, has, in the intricate way just described, become contaminated with useless and injurious refuse materials, some of which are quite as foul as the discharges from the bowels or kidneys, it is obvious that it ought not to be taken again into the lungs, even if it were as pleasant as fresh portions of the

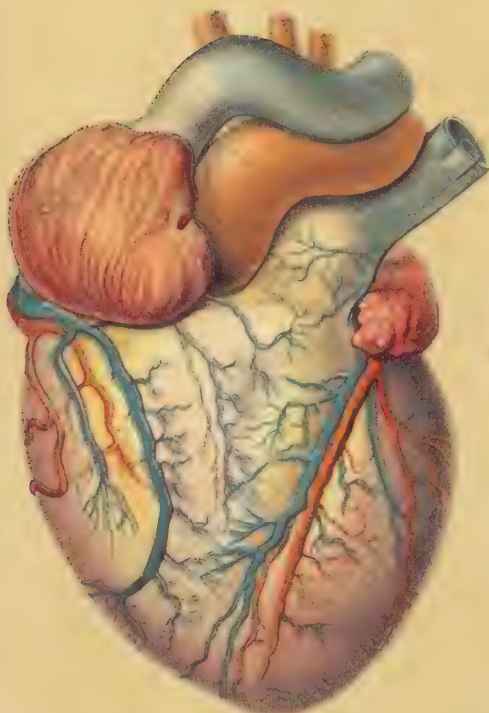




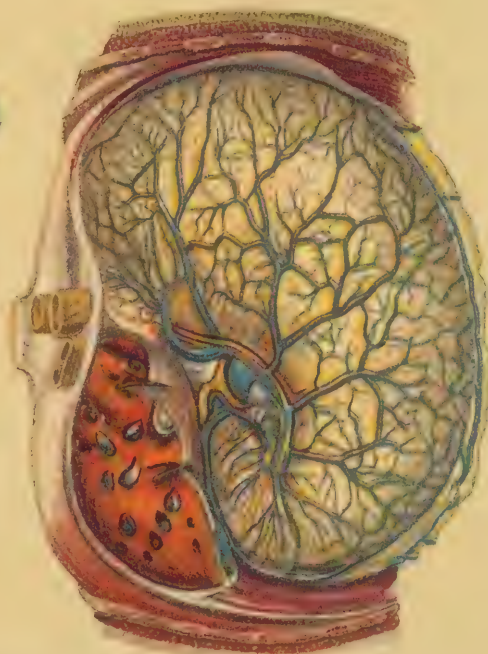
*Lungs and Heart in Position.*



*Section of Liver.*



*The Heart, Showing the Great Arteries*



*The Stomach, Front View, Figure in Reclining Position.*

*Human Internal Organs.*





atmosphere. How much more, then, must every refined and cleanly person shrink from inhaling into the very recesses of his or her body, air which is loaded with the foul emanations and worn-out refuse cast off at every breath, by the filthy, often diseased, people who push their way into most crowded places, and especially into the ill-ventilated halls, lecture-rooms, and theatres which abound all over the country in villages, towns, and cities? If it were anything else but air, the very idea of using it thus at *second hand*, after its ejection by dirty and unwholesome persons, would be horribly disgusting; but because these impurities of air are invisible to the naked eye, they are unhesitatingly drawn into the lungs of refined gentlemen and delicate ladies, without a thought of their degraded nature, their debased origin, or of their poisonous power. The presence of refuse animal matter is easily shown by the microscopical examination of air, and also by drawing the air of an overcrowded apartment for ten or fifteen minutes through water, which will wash out some of its foulness and become proportionately filthy and ill-smelling. Most people, however, need no evidence in regard to this question, being able to recall the proof which their own noses have afforded, during some visit to the crowded wards of an almshouse, the overflowing lodging-room of a police station, or the narrow, low-ceiled dwellings of poverty and want. Even a large hall will have its air rendered foul and unwholesome in a single hour by the breaths of a hundred people; and, of course, exactly the same impurities with which these hundred persons polluted the atmosphere in an hour, would be given off from the lungs of ten persons in ten hours, or during the period of a long winter's night.

#### Evil Effects of Exposure to Draughts.

The unrestrained action of cold air, and especially of cold moist air, blowing upon the skin, is so often a cause of diseases in great variety, that the consideration of this constantly impending danger to health, and its hygienic prevention by the use of suitable clothing, and so forth, is very important.

Contrary to the popular notion, clothing gives no heat in itself, but only saves the heat of our bodies from escaping into the surrounding air, and it does this just in proportion as it is a bad conductor of heat. The rate at which our raiment carries off the bodily heat varies from that of a thin linen coat, for example, which conveys it away rapidly, to that of a thick fur cloak, through which the loss of heat into the surrounding air is very gradual. Upon this difference in conducting power for heat the relative value of different articles of dress depends.

Much of the comfort that clothes afford is due to the fact that they give what is called an "artificial surface" to our bodies, on which the cold air can act without our feeling it so much. It is the absence of this artificial surface on the bare hands and face which makes the fingers, forehead, and

ears ache so with the cold, sometimes in wintry weather, and the reason that people's toes, after a while, often ache in the same way, is that the foot-coverings frequently become chilled through, so that they no longer do their duty as protectors against loss of heat. The process of "hardening oneself" consists in rendering the skin so used to changes from a warm to a cold air, that its blood-vessels and nerves are comparatively little affected by the contracting influence of the cold. "Making oneself tender," on the contrary, is establishing the habit of staying in warm air, and venturing out only when well wrapped up, to such an extent that any accidental exposure to even moderately cold blasts has a powerful, or even dangerous, effect. Hardening the skin against the weather is just like hardening the eyes to a bright light, or the ears to loud noises. All three may occasionally prove valuable accomplishments after they are acquired, but a certain per cent. of the people who try to be thus accomplished will lose their lives, or their eyes, or their ears, in the process. No doubt thousands of young girls have died of consumption caught in the attempt to harden themselves to going with bare arms and bare necks, in the costume absurdly called "full dress" by fashionable society.

In every effort to harden oneself against the influence of changes of the air, and likewise in the practice of that accomplishment after it is acquired, any saving of clothes is often more than compensated for by a waste of extra food used up in maintaining the animal heat, through the process of burning up the fatty and starchy articles of our diet. Besides this, a great and frequently an unnecessary strain is imposed upon the digestive organs, in preparing this extra supply of nutriment, and the nervous system is also severely taxed in regard to both the digestive and the heat-regulating operations, so that study or other mental efforts may be seriously interfered with. Hence the hardening process should only be applied to our bodies in the most carefully considered way, by people who are, at the time the experiment is tried, in good health, and those especially who are free from any tendency, inherited or otherwise, to disease.

As a substitute for hardening oneself by exposure to all sorts of atmospheric changes, without carefully regulated protection, attention to the weather indications, or "probabilities," as published every day in the newspapers, has of late years become of great importance from a hygienic point of view. In fact, the study of Sanitary meteorology, as this branch of the science might be called, for the purpose of determining what hygienic precautions in regard to clothing ought to be instituted against hot, moist, or cold air, what days or what hours convalescent patients, and especially children, may venture out of doors, when is the best time for invalids to bear removal, and at what periods neuralgic and rheumatic patients must exercise particular care against exposure, has a highly practical, and sometimes an almost incalculable, value. Any one, by con-



sulting the daily "indications" in the public prints, can provide against the weather correctly about eight times out of ten, but in order to avoid most of the remaining twenty per cent. of blunders, it is only necessary to combine the knowledge obtained from the signal office predictions with that derived from observations upon an aneroid or mercurial barometer, as is described in the following pages.

### Value of Weather Observations.

From the time the great Dr. Johnson uttered his famous sarcasm upon observers of the weather, to wit, "A certain set of men pass their lives in watching the changes of the weather, and die at a good old age with the conviction that the weather is changeable," little has been accomplished in rendering us more truly weather-wise, until the splendid results attained by our own Signal Service Bureau gave a new impetus to the study of meteorology.

Few can dispute that not only the hygienists of America, but also those of the Old World, are under great obligations to our National Government, which, taking timely advantage of opportunities never before presented in the history of mankind, has utilized them with marvelous success.

These opportunities consist, of course, in the circumstances, first, that in our American Union there is a larger compact portion of the earth's surface inhabited by civilized man, now under the same jurisdiction, and controlled by one central authority, than in any antecedent epoch; and second, that by the most extended system of telegraphic communication ever organized, it has been possible, during the last decade, for the first time in the history of the world, to obtain instantaneous and simultaneous weather reports from an area of the earth's surface occupying the whole breadth of our continent, stretching from the thirtieth almost to the fiftieth parallel of latitude, and comprising more than three millions of square miles.

Over this vast section of country signal stations have been established, under the direction of the Weather Bureau, at least wherever practicable, and to such extent as the yearly appropriation would permit. At these stations three observations are taken daily, at the same moment, the hours selected being 7 o'clock A. M., 3 P. M., and 11 P. M., Washington time. By this plan the changes from hour to hour and day to day, as well as the effects which are produced by these alterations, are noted, and after these records are forwarded to the central office, they are reproduced in a permanent form upon the daily weather map, which is transmitted as far as practicable over the country. Hence these daily maps may justly be entitled "the geography of our atmosphere." Without examining them, we can no more secure an accurate conception of the general state of the weather, than we could gain a correct idea of the real arrangement of

seas, continents, and islands, as represented upon geographical maps, by walking a few miles along the coast, or climbing over a range of mountains.

By means of the extensive series of observations, carried on through several years by the United States Signal Office, it has been discovered that storms occur in areas of low barometer, rounded or oval in form, and two or three hundred miles in diameter, which travel across our country, from west to east, exactly opposite to the apparent movement of the sun in the heavens. The storm therefore is an immense ring or oval of wind, clouds, and rain, which speeds across the country about as rapidly as a fast express train, that is, from about 300 to 600 miles in twenty-four hours. Such storms usually come to us from the Pacific coast, and by having telegraphic messages sent to Washington from several of the western stations on the Pacific railroad, announcing at what time the storm reached each one respectively, the observers of the signal office can, of course, tell just how fast that particular tempest is advancing, and calculate when it is due in Washington, exactly as the railroad officials can tell, if they are informed by telegraph, precisely what time their train will arrive from the west. Evidently, after being thus notified, it is an easy matter for the Washington authorities to send word to the people in the neighborhood to get ready to meet the rain in one instance, or their friends at the depot in the other.

The path of an area of low barometer across the continent has been aptly compared to the track of an immense water-cart, the centre of which is, as a general rule, the line of most violent storm. The average rate of motion for such a storm-centre is 350 miles a day, although it may vary from 100 to 1200 miles in twenty-four hours. The winds commonly blow from all quarters towards the area of low barometer, the many apparent exceptions being caused by mountain-ranges, valleys, etc., turning aside the currents of air. From this it follows that, when the area of low barometer is running on a line of high latitude, the winds felt in places on its southern margin will be from the south, and *vice versa*. That is to say, if at any time an area of low barometer is passing through New York and New England, the winds in Philadelphia will, in a general way, be towards it and from the south; while, on the contrary, at any time when a similar area is travelling through Virginia and Maryland, the winds in Philadelphia will be from the north, and usually cooler. The exceptions to the rule of north winds being cooler and south winds warmer, are obviously due to large volumes of cold air or of warm air, respectively, having previously been blown to the north or south of a particular position.

Although the general direction of the areas of low barometer seems to be round the earth towards the rising sun, their course is sometimes very irregular, as is demonstrated by the daily weather maps, which occasionally

exhibit them travelling almost due north for three or four days, during which excursion they may pass over a distance of a thousand or fifteen hundred miles, before they resume their usual easterly tendency. The storm, as before remarked, is where the area of low barometer is, and as this almost always approaches us from the west or south-west, most of our storms really come from that direction. Hence there is seldom or never a true north-east storm, much as we hear people talk about "north-easters;" and a north-east wind, with rain, results from an area of low barometer situated south-west of us, and, as a rule, travelling eastward on a parallel of latitude one or two hundred miles south of our position.

The use of the barometer is especially seen in determining, by its steady and gradual rise, that the edge of an oval of low barometric pressure has passed over a particular place. It also indicates, by its gradual fall, the oncoming of an area of low barometer, although when, as frequently happens, a storm lags behind this area a little, rain and wind may be most severe with a rising barometer. The indications afforded by barometric observations must therefore be specially studied for each particular place, and judiciously combined with the daily report of probabilities from the Weather Bureau, in order to gain the greatest advantage in sanitary meteorology.

### **Influence of Winds on Health.**

Wind or air in movement exercises upon human health an influence which depends partly upon its rapidity, partly upon the properties which it may have acquired from the land and water over which it has passed, and lastly upon its variations. Its influence from these various causes may be either accidental and temporary, or durable and more profound. Thus, the effect of a cold or damp wind upon an individual who is in a free perspiration, as a consequence of active exercise just engaged in, may be to produce a cold, a sore throat, a bronchitis, or an attack of rheumatism, according to the predisposition or weak point of the person. Hence, as already insisted upon, every man ought to study out carefully his own special aptitudes, under the agency of certain exciting causes, to the development of particular diseases. This is indisputably the part of wisdom, because it is far easier to avoid these exciting causes, which may so readily bring into action the dangerous maladies to which we are predisposed, if we are well informed concerning the exact defect in our armor against their power. A wind, if charged with injurious substances, such as the pestilential effluvia of marshes, for example, may carry with it the causes of serious alterations in the health. Some such winds produce, in countries where they blow, diseases terrible both on account of their severity and their persistence, and which cease only with the wind which has brought them. Difference in the rapidity of the movement of air gives rise to great variations in its effects. A moderate agitation of the air,



such, for instance, as a wind moving ten miles per hour, is decidedly favorable to the proper performance of the functions of the skin, to the energetic exercise of the muscular system, and to the maintenance of an agreeable temperature. Nothing, for example, can be pleasanter, nor in their way more healthful, during the exhausting heats of summer, than the sea-breezes of maritime coasts. When cool air is in rapid motion, however, and just in proportion to that activity, a great and speedy abstraction of heat from the surface of our bodies is perceptible. Air which in repose gave merely the sensation of agreeable freshness, becomes cold when in movement, and cold air under a similar change of circumstances becomes frigid. Physiologists have calculated that, with dry air in rapid motion, the loss of moisture from the surface of the skin is ten times as great as when the air is still and moist. This fact explains the necessity of avoiding, as far as possible, exposure of the body, particularly when perspiring, to air in rapid motion, because the dangers of chill are thereby greatly increased. On the other hand, a very dry wind rapidly parches the skin, checks its secretions, which are so important to the maintenance of health, and produces a general feeling of discomfort. The exaggerated condition of this prejudicial influence is seen in persons exposed to the celebrated sirocco of the Great Desert of Sahara.

The influence of winds depends not only upon their humidity and their rapidity, but also upon the nature of the countries which they traverse. The wind which crosses the icy peaks of snow-clad mountain-ranges carries with it for a long distance the cold with which it is charged. The town of Nice, such a favorite resort for consumptives in the south of Europe, would have an almost perfect climate were it not for the fierce and frigid wind called the *mistral*, which occasionally visits it, blowing from the summits of the Alps down the valley of the Rhone.

Certain ocean currents, such as the curious Gulf Stream of our Atlantic Coast, communicate to the winds which blow over them a large share of their warmth and moisture, and thereby ameliorate the climate of islands and coasts within their sphere of operation. Dust of various kinds, volcanic cinders, germs of disease, and infectious miasms are often carried by winds to immense distances—thus, for example, the ashes from an eruption of Vesuvius have been wafted to the Grecian coast, and the poison of intermittent fever has been known to travel in this way for fifty or sixty miles. In view of these facts, it is obviously important to make good use of natural eminences, groves of trees, and other obstacles, between inhabited houses and unhealthy marshes, etc., so situated that strong currents of air frequently prevail between the latter and the former.

### Ozone as a Sanitary Agent.

Among the invisible ingredients of air sometimes found in considerable quantity, but not always present in any appreciable amount, is ozone. This agent, which is believed to be an energetic modification of oxygen, probably has an important bearing upon human health, and perhaps upon the spread of epidemic diseases. As yet, the researches of medical chemists only enable us to state that the test of Shoenbein indicates that ozone is more abundant in pure than in impure air; in greater quantity at the seashore than in the interior, and in mountain air than in that of plains; absent in the centre of large towns, yet present in their suburbs; deficient in the air of a hospital ward, yet plentiful in the atmosphere outside. Dr. Nicholson, of Michigan, found in a long series of observations that ozone was more abundant in a pine forest than in the open country during the summer, but less abundant during the winter; less abundant in coal-pits and over swamps than in the open country, and less abundant generally in the night than in the day. The results of these investigations in regard to the air of pine woods are in accord with the statements of Dr. Schreiber, of Vienna, who declares that the turpentine exhaled from pine forests possesses to a very high degree the property of converting the oxygen of the air into ozone, and this fact perhaps explains why a continued residence among the balsamic odors of the pines has long been credited with a favorable influence in cases of consumption. The test for the presence of ozone in the air, consisting of paper which has been soaked in starch and iodide of potassium, or iodide of calcium, is unfortunately not reliable; but for the existence of carbonic acid and its associated deleterious animal matter derived from breathing, we have an excellent test in the lime-water experiment already described. Dr. Angus Smith has contrived an ingenious method for employing this reagent so as to give good practical results. This device is called Angus Smith's simple household test for carbonic acid, and is applied as follows: Procure a bottle holding ten and a half fluidounces, fill it with the air of the room you wish to examine, by blowing it in with a pair of bellows, or sucking it in through a glass tube pushed down to the bottom of the vial, or by simply filling the bottle with water and emptying it in the room you wish to test. Pour in half an ounce of lime-water, and after corking tightly, shake well for two or three minutes. If, after a short time, there is no milky appearance of the lime-water, you may know to a certainty that the ten ounces of air in the bottle do not contain enough carbonic acid to form a visible precipitate of carbonate of lime (chalk) in the lime-water, and this has been proved by careful experiment upon a large scale to be less than six one-hundredths of one per cent. of carbonic acid in the sample of air tested—a quantity which has been agreed upon by high sanitary authorities as the limit beyond which the accumulation of this

impurity, and of others which, as already mentioned, are much more noxious, and which seem always to accompany it when it arises from human or animal respiration, is injurious to health and should not be permitted to occur.

In the absence of chemical apparatus and reagents, we are often compelled to rely upon the examination of air by the senses, especially that of smell, and, by the aid of a little practice, this plan affords tolerably reliable results. It is necessary to observe the precaution that, in order to avoid blunting our power of perceiving odors, we must remain for some little time, previous to trying any given experiment, in the open air, just as, in order to distinguish by the eye between faint lights of moderate intensity, we would previously close our eyes for a few minutes, or remain a short time in a darkened room. In a majority of instances, the degree of atmospheric impurity perceptible in a shut-up room may be expressed by the terms suggested by Dr. De Chaumont, of "rather close," "very close," "foul," "very foul and offensive," which expressions furnish a descending scale for indicating unwholesome contamination of the air. The first of these refers to a condition of the air in which there is nearly seven-tenths of a part of carbonic acid from breathing in one thousand parts of air, whilst the phrase "very foul and offensive" applies to a degree of impurity about twice as great, or one part and four-tenths of a part in the thousand.

The injurious effects of air which is not impure upon the human system can scarcely be separated from the influence of heat, or more especially of cold, upon the different members or organs of the body. Thus, for example, the production of neuralgia of the face or head, muscular rheumatism in the limbs or back, and bronchitis, pneumonia—that is to say, inflammation of the lungs or lung fever—and consumption of the lungs, are chiefly due to the action of a low temperature brought by currents of air. These departures from perfect health in their incipient stages, and the means of avoiding them, will therefore be considered under the head of Cold as a Cause of Disease, whilst the hygienic management of the several maladies will be found in the second portion of this work.

### **Poisonous Effects of Impure Air.**

The most common impurity of air is carbonic acid, with its associated organic matter from human or animal breathing, which pollutes the atmosphere of closed or badly ventilated apartments in the manner already described. Acute poisoning from contaminated air, such as took place in the Black Hole of Calcutta, is very uncommon, because people who are long shut up in overcrowded rooms always feel such an overpowering need of fresh air, that they can only be prevented by main force from hurrying away from the danger to which they are exposed. Nature warns them so emphatically and imperatively to seek a purer atmosphere, that they



become ready to sacrifice everything to obey her commands. The early symptoms of oppression from breathing impure air are too well known to require any lengthened description, although the direct connection of many uncomfortable sensations experienced in crowded rooms, with the aerial contamination, is not so generally understood and appreciated. Among the primary indications of physical injury to the blood from inhaling vitiated or "second-hand" air, are a disposition to draw long, full breaths, as a result of the stifled or almost suffocated feeling which early makes itself apparent. This is accompanied, or soon followed, by flushing of the face, throbbing of the temples, headache, and sickness at the stomach, which may even proceed so far as faintness or an actual fainting-fit, as we often see in delicate ladies accidentally wedged in crowded lecture-rooms, concert-halls, or theatres.

The chronic effects of long-continued breathing an air which is but moderately polluted, are seen in a general deterioration of the strength, appetite, and digestion, a pallid dyspeptic appearance, from want of renewal of the blood, and particularly in the development of scrofula and consumption. These latter diseases are now known to be the direct results, in many instances, of inhaling vitiated second-hand air, and the terrible suffering and enormous fatality which they entail upon mankind for generation after generation ought, by themselves, to be sufficient to prevent us from neglecting any precaution against such enemies to our race.

### **The Importance of Ventilation.**

The great remedy against impure air is, of course, proper ventilation; and as this subject has been very fully studied by such able sanitarians as Parkes, Pettenkofer, and De Chaumont, we fortunately possess an amount of knowledge in regard to it bearing some proportion to its importance. In arranging any system of ventilation, we may assume that the greatest amount of carbonic acid (and its associated organic material from the breath) which may be allowed in an inhabited room, without injurious results, is six-tenths of a gallon in every 1000 gallons of air, as already mentioned. The first question then is, how much fresh air must be supplied every hour for each person in a room, in order that this proportion of impurity may not be exceeded? By experiment and calculation it is found that, in order to keep up this admitted standard of purity, it is requisite that 3000 cubic feet of perfectly pure air should flow into a room hourly for every grown person occupying it. Of course, an equal bulk of more or less vitiated air must escape to give place to the pure air, and this bulk, which must be poured in and likewise emptied out hourly for each individual, would be equal to the contents of an apartment thirty feet long, ten feet wide, and ten feet high. Such a quantity, large as it seems, must sometimes be considerably increased, in order to maintain the requisite standard of purity. For example, when lights

are used, and no provision is made for carrying away the products of combustion, much additional pure air is needed. An ordinary gas-burner consumes the oxygen of about twenty-five cubic feet of air hourly, and produces nearly as much carbonic acid as ten men would do in the same space of time. Sick people, especially those with diseases of the lungs, and those affected with low or putrid fevers, should have a larger quantity of pure air; and it has been found that, unless 3500 or 4000 cubic feet are supplied hourly for each patient, hospital wards, for instance, are more or less haunted by offensive odors.

The size of apartments for human habitation should be directly dependent, within certain limits, upon the perfection of the ventilating and warming apparatus, because, if the room is small, it is only by securing a proper delivery of warm air that the occupants can receive their allotted 3000 cubic feet per head per hour, without suffering from dangerous or unpleasant draughts. For instance, in a room containing but 100 cubic feet, the air must be changed thirty times hourly, or every two minutes, in order to maintain the atmosphere at its standard purity. This would involve the necessity of such rapid currents of air flowing through the narrow space, that it would be almost uninhabitable. Besides, when the room is small, it is not possible to diffuse equally the air which enters it, because, between the inlet and the outlet, a direct current is apt to be established, so that a good deal of the fresh air passes right through, without being of any use in reducing the amount of impurity.

The best authorities assert that, with ordinary means of ventilation, the space for every grown person should be not less than 1000 cubic feet, and that in this space the entire air should be changed three times each hour. According to this rule, a sleeping-room of ten feet wide, ten feet high, and twenty feet long, might be allotted to two people; and four persons, *but no more*, should sit, eat, or sleep in a room twenty feet square and ten feet high, provided it was well ventilated in the ordinary way. If the best ventilating apparatus is employed, and the air is warmed to the temperature of about 65° Fahrenheit, the air in a room may be changed six times hourly without causing annoyance, so that, under such exceptional conditions, an apartment of less than half the size above mentioned, or twelve feet wide, fourteen feet long, and ten feet high, would answer for four people. The dimensions given above are, unfortunately, very much larger than are generally provided in our dwelling-houses, and in the crowded lodgings of the poorer classes the allowance of space for each person often falls as low as 250 or even 200 cubic feet. Under the latter circumstances, the increased sick-rate and death-rate, and the general aspect of what a celebrated French physician graphically describes as "physiological destitution," bear witness to the disastrous effects of breathing impure air in confined apartments.

A certain amount of natural ventilation, as distinguished from artificial

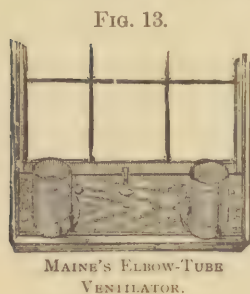
ventilation, effected by contrivances especially arranged for that purpose, goes on all the time through the many crevices, holes, and pores of our dwellings, although this supply of air is, as a rule, but a small part of what is necessary for our health. It contributes, however, to the change which does progress, whilst we sit quietly within our four walls without feeling the least draught. Since air, like other gases, expands or contracts according as it is heated or cooled, warm air is, of course, lighter than cold air, and tends to escape at the upper part of a room, whilst its place is supplied by cold air, which flows in through every aperture in the lower portion. The familiar experiment of opening a door leading to a cold entry an inch or two, and then holding a lighted candle first near the bottom and then at the top of the crack, shows very clearly, by the way the flame is blown inward in the first instance, and outward in the second, how strong are the currents of air in these two positions. Many persons, especially ladies, are so sensitive to the effects of second-hand air in a room, that they can tell in a very few minutes, by the sensations in the head and lungs, whether an agreeable amount of ventilation has been provided, by leaving the door a little way open, or whether it has been shut tight. The rapidity with which the necessary interchange of air goes on through the crevices of our doors and windows, depends very much upon the difference between the inside and outside temperature. This important fact is well illustrated by the following observations of Pettenkofer. He found that, in a room ten feet high, ten feet wide, and twenty-six feet long, containing 2600 cubic feet, when the difference in temperature within and without was  $34^{\circ}$ , the contents of the apartment changed once in an hour, through the ordinary crevices of the doors and windows. In the same room, with the same difference in temperature, but with a roaring hot fire in the stove, the change in the air increased about one-fourth. When, however, in the same room the thermometer stood at  $71^{\circ}$ , whilst outside it registered  $64^{\circ}$ , leaving a difference of only  $7^{\circ}$ , ventilation went on only at the rate of 780 feet per hour, and even opening a window, the aperture of which equalled eight square feet, only increased the ventilation about one half, or to 1060 cubic feet. This experiment was very instructive, showing, as it does, that a difference in temperature of  $34^{\circ}$ , with carefully shut doors, windows, and crevices, has as great an influence in securing a pure atmosphere as much larger and quite unobstructed communications with the outer air, when this latter is of nearly the same temperature as that inside.

The quickest way of getting rid of foul air in a room is by cross ventilation, or "perflation," as it is sometimes called. This is obtained by opening windows on opposite sides of the apartment when a moderate breeze is blowing; but it is a method which cannot be relied upon, because, if the outside air is stagnant, no ventilation is secured; whilst, on the other hand, if there is a strong wind, the violent current of air produced might be unendurable.



In all rooms which are occupied most of the day, and in all sleeping rooms, proper ventilation should be secured by artificial apparatus specially designed for the purpose, as will be described in the section of this book upon Sanitary Architecture. In old houses, until proper alterations can be made, the exit of foul air ought to be provided for by lowering the windows at the top, and the entrance of fresh air permitted by raising them at the bottom. Unwholesome draughts may be prevented in the latter instance by the simple device of fastening a board across the window-frame on the inside, in such a way as to direct the incoming current of air upward toward the ceiling of the room. Dr. Keen's arrangement, which is still simpler and equally efficient, is to fasten, with tacks or pins, a piece of cloth, or even strong paper, across the lower ten or twelve inches of the window-frame, and then raise the lower sash more or less, according to the weather. The convenience of this contrivance is increased if the cloth, instead of being permanently fastened to the window-frame, is held in its place by loops of tape, which allow of its easy removal as occasion requires.

Another very satisfactory little piece of apparatus is Maine's elbow-tube ventilator (Fig. 13). This consists of a board made in two parts, sliding upon each other so as to be capable of adjustment to windows of different widths. This is to be furnished with two pipes or tubes about six inches in diameter, each bent upward at an elbow and supplied with a valve. Elbows of stove-pipe answer a very good purpose, and, when in use, the board is to be placed under the raised sash, as shown in the marginal illustration, and the flow of cold air through the tubes regulated by the valves which they contain.



### Contamination of Air by Sewer-Gases.

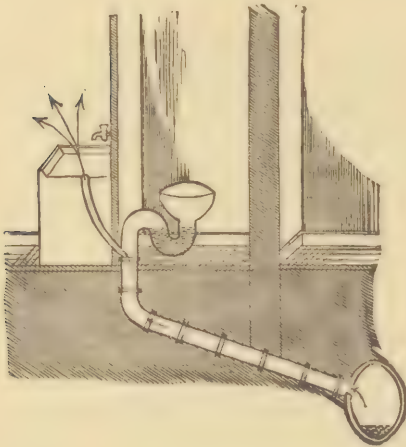
A second great danger of impure air arises from its pollution by emanations from sewers and cess-pools, which frequently contain the germs of typhoid fever, diphtheria, and perhaps other complaints, as will be more fully explained under the head of Contagion as a Cause of Disease. Dr. Letheby found that sewage-water excluded from the air and containing 128 grains of organic matter to the gallon, gave off over a cubic inch of foul-smelling gases per hour for a period of nine weeks. Of course, the danger to persons who inhale sewer-air, or "sewer-gas," as it is often called, depends very much upon whether it is loaded with disease-poisons as well as with foul odors, and the instances adduced by well-meaning but ignorant persons, for the purpose of showing that the emanations from sewers have proved harmless, are chiefly cases in which ill-smelling gases happened to be *unmixed* with the poisons of disease. It would be just as well to argue that because hundreds of ships cross the Atlantic in

safety every year, therefore no shipwrecks ever occur, as to contend that, because many people breathe sewer-gas with impunity, therefore it is never injurious to human health. That some sewer-gas is highly deleterious in its nature, is proved by the following stubborn facts; and since we have as yet no tests for determining accurately the degree to which any particular sewer is infected with the germs of disease, our safest plan is to cut off all connection between the air of our houses and that of those dangerous channels for filth and disease-poisons.

Although this subject will be considered more fully in another section, protection against the disease-poisons which enter our systems with air polluted from sewers is so important that two illustrations are here presented, showing what very often occurs.

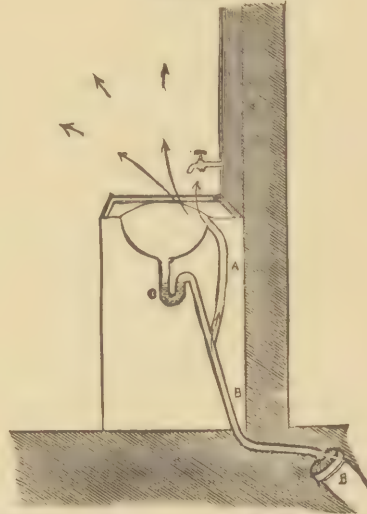
In Figure 14 is indicated how the untrapped outlet-pipe of a sink or stationary washstand may conduct the poisonous emanations from an

FIG. 14.



SEWER-GAS FROM UNTRAPPED WASHSTAND.

FIG. 15.



SEWER-GAS FROM A BADLY TRAPPED WASHSTAND.

adjoining water-closet, or from the sewer below, directly into a bedroom or other inhabited apartment. In Figure 16 is seen how the overflow-pipe of a trapped stationary washstand may be the avenue of dangerous or fatal poisoning by sewer-gas, as in some of the instances next mentioned:

Dr. William N. Thursfield, of Birmingham, England, reports in 1878 tracing an isolated case of diphtheria to temporary exposure to sewer-gas in a house on a short line of sewer which he *knew* to be specifically contaminated by diphtheria. This sewer, when opened and examined by a surveyor, produced in him a severe diphtheritic attack.

Dr. William V. Keating, of Philadelphia, in 1879, details at length four cases of typhoid fever attributed to sewer-gas from untrapped drain-pipes,

and refers to cases of measles, scarlet fever, and diphtheria in two other families apparently from the same cause.

Dr. C. W. Chamberlin, of Hartford, relates a remarkable case of fatal erysipelas in 1880, seemingly due to sewer-gas from a waste-pipe carelessly left open beneath the bed of the patient.

Dr. George Wilson quotes the account of twenty out of twenty-two boys of Clapham, England, who were attacked, and two of them died, with violent vomiting, purging, and fever within three hours after standing over a choked-up drain, watching the workmen cleaning it out.

Nor are these isolated instances, for the medical journals of America and Europe record numerous similar examples of dangerous or fatal effects from disease-poisons in sewer-air when inhaled by human beings.

In view of this great body of evidence, showing the direct conveyance of disease by air from sewers, it behooves us all to avoid the access of such noxious effluvia into our houses, or into any inhabited place whence they can penetrate into the lungs, which are the usual avenue of entrance into human systems.

Such a desirable object is probably best accomplished by mercury seal-traps, which form complete metallic bars to the entrance of foul air and disease-germs. When these improved mechanical appliances cannot be obtained, ball-traps or ventilated U and S traps, if faithfully disinfected at short intervals with a strong copperas solution, 8 ounces to the gallon of water, or with chloride of lime or solution of carbolic acid, 4 ounces of Calvert's No. 8 to the gallon of water, afford safeguards which should be far more generally employed (see Sewerage and Drainage).

### **Dust in the Air as a Cause of Disease.**

Dust of various kinds floating in the air, and often occurring in such minute particles that it can only be recognized in a bright sunshine, or by the aid of a beam of electric light, as Professor Tyndall has shown, is a far more potent cause of disease than is generally supposed. Although affections of the stomach and bowels are often induced by the introduction of particles of injurious dust swallowed with the saliva, diseases of the lungs are chiefly to be dreaded when air loaded with substances which are mechanically or chemically noxious find their way to the delicate mucous membrane which lines the recesses of our pulmonary organs. Bronchitis, catarrh, and acute or chronic pneumonia, the latter often running on into one form of consumption, are especially to be guarded against in persons who are liable to be forced to inhale dust of various kinds. The effects of dust are chiefly dependent for their severity on the large amount of the offending material, and the angular, rough, and hard character of its particles. A large number of the unhealthy trades are insalubrious especially from this cause. Thus, for example, it is stated by Mr. Simon that, excepting in one locality, 300,000 miners break down



in England prematurely from bronchitis and pneumonia caused by the atmosphere in which they live. The one exception is most important, because it occurs among the colliers of Durham and Northumberland, where the mines are well ventilated. The sharply-angular fragments of coal which may be seen under a microscope to constitute coal-dust, mechanically irritate the lungs of those who inhale them, and often give rise to the kind of consumption which is so peculiar that it is called miners' consumption or miners' phthisis. This malady alone cuts short the days of an immense number of laborers among coal-dust, and after death their pulmonary organs are found filled with sharp particles of coal, which being inhaled with the breath, become imbedded in the substance of the lung, and then acting like a vast quantity of tiny splinters in the flesh, give rise to innumerable minute boils or abscesses, by which the breathing apparatus is actually riddled with holes, and so much of it destroyed that the poor sufferers die for want of lung-substance enough to supply properly their blood with air.

The fine particles of steel and of sand thrown off in grinding saws and other tools, give rise to saw-grinders' consumption, particularly when dry-grinding is resorted to, and unless the dust is carried away from the workmen.

In manufacturing these various steel and iron implements, the rough articles are firmly pressed against grindstones, which are revolving sometimes at the rate of three thousand times in a minute. Practically it is found that the degree of danger to the workmen thus employed depends partly upon the amount of dust inhaled, partly upon the character of the particles composing this dust, and partly upon the constrained attitude which the workmen are frequently compelled to assume. The grinding of needles and forks is the most dangerous, because it must be done upon dry grindstones, in order to reduce the chance of the fabricated utensil becoming rusty. Scissors, razors, and table-knives can be ground partly upon wet grindstones, so that the men employed in such work run less risk of injury from it, whilst the coarser implements generally are now, as a rule, finished upon wet stones entirely, so that still less danger is incurred. The grinder's consumption, called also the grinder's asthma from the difficulty of breathing, which is one of the prominent symptoms, comes on very gradually, and often lasts four or five years before it proves fatal. At first there is only a little dry cough, with scanty expectoration; later on the mucus, which is coughed up, begins to be reddish from a minute quantity of blood mingled with it; and, although there is no fever, and the strength and appetite remain good, an examination of the chest with the stethoscope reveals serious trouble in one or both lungs. Still, recovery is not only possible, but probable, at this stage of the complaint, if the workman can be persuaded to abandon his occupation; but if he persists in exposing himself to the perils incurred by breathing these

dangerous dusts into the lungs, the pulmonary structure soon begins to ulcerate away, and painful, lingering death by consumption follows.

Until recent improvements in regard to grinding, the fatality of these particles of dust, when inhaled into the lungs, was very great. According to Dr. Holland, the average age at death of twelve workmen at the trade of needle-grinding was only thirty years and eight months, and other authorities give the duration of life as from thirty-one to thirty-five years. In Wheeling, West Virginia, the dust of nail-factories is so injurious that "nailer's consumption" is very common, and certain life insurance companies refuse to insure any operative in the grinding department of the works. In factories where steel-grinding goes on to a very great extent, the use of a large magnetic plate, for drawing to itself the metallic particles, is very useful; but, of course, it has no power to purify the air from any injurious dust, except that made up of iron or steel, and perhaps on this account, it has never been popular among the workmen. One might suppose that it would not be difficult to devise a mouth-filter or mask to be worn over the face, and exclude the dust, whilst allowing the purified air to enter the lungs. Practically it is found, however, very difficult to construct a piece of apparatus of this kind which will keep out the dust, and yet remain unobstructed by the moisture of the breath, which condenses upon the material of which the filter is made. Dr. Richardson, of London, has arranged a very ingenious mask for this purpose, which is fitted with a breathing-tube, around the inside of which feathers are rolled in such a position that when the air is drawn through the tube they will rise up and filter it, and during the reverse process of expiration, they will be flattened down against the sides of the tube by the current of air, and leave an open channel for it to be breathed out. By this plan it would seem that lightness, dryness, good filtration, and self-cleansing of the filtering material would be secured; but, strange to say, it has not been approved by those who wear it. The workmen complain that it causes closeness of the air and looks unsightly, but it certainly merits a more extended trial before being abandoned.

Another very efficient method is to draw away the dust in the strong current of air created by a powerful mechanical fan. A single fan may be made to extract the dust from several grinding-stones, care being taken to have the opening in the boxes which surround the stones and in which the draught is set up underneath, so as to extract both the heavier and lighter particles. This plan adds materially to the expense of manufacture, and is therefore not very popular among the mill-owners, but it so greatly diminishes the dangers to the workmen, when properly adapted, that its employment should be enforced by law, in order to protect the health of the operatives. Although the introduction of wet-grinding for the coarser tools vastly decreases the chance of mechanical injury to the lungs from floating particles in the air, the artisans are often kept covered



with the muddy water which is constantly being whirled off from the stones. Being thus exposed to the combined evil influence of cold and wet, they are especially subject to acute bronchitis, pneumonia, and rheumatism, which may, however, be in part prevented if the men wear waterproof clothing whilst they are at work.

In the pottery trade there is often a large amount of dust made up of mineral particles, which are very irritating to the lungs of the operatives employed. The same may be said of the artisans who work at the trade of glass-making, the most dangerous department being that of grinding and polishing the cut-glass. Of these men more than one-third are said to die of consumption, and their average age at death is variously estimated at from thirty to forty-two years.

In flax factories a very irritating dust is produced in the processes of hackling, carding, and tow-spinning, and Dr. Greenhow states that, of 107 operatives examined indiscriminately, no less than seventy-nine were suffering from bronchial irritation, and in nineteen of these cases there had occurred that serious symptom of consumption, bleeding from the lungs. In the carding-rooms of cotton, flax, and silk-spinners, there is also a large amount of dust and loose vegetable fibres, which frequently set up dangerous irritation in the lungs of the workmen, who breathe the air thus loaded with injurious impurities. The makers of matches, who are exposed to the fumes of phosphorus, suffer from a form of ulceration of the jaw-bone, if there happens to be any uncovered portion upon which the poisonous vapor can act, as for instance, around the root of a diseased tooth. The manufacture of many chemical products is exceeding dangerous to health, and requires special precautions to reduce its evil influence as far as possible.

In some trades and under certain circumstances, the fumes of metals or particles of metallic compounds pass into the air, and render it very injurious to health for those who happen to breathe it. Brass-founders are affected with bronchitis and asthma, as in other trades where dust is inhaled by the workmen, but in addition they suffer from a disease called brass-ague or brass-founders' ague. It appears to be the result of inhaling the metallic fumes, perhaps of the oxide of zinc. The symptoms are tightness and oppression of the chest, with uncomfortable nervous sensations, followed by shivering, an indistinct hot stage, and lastly profuse sweating. The attacks, unlike those of genuine ague, are not periodical. Coppersmiths are apt to be affected in a similar way by the fumes arising from the partly vaporized metal or from the solder. Tin-plate workers likewise suffer occasionally from the fumes of the soldering. Plumbers are liable to inhale the volatilized oxide of lead which rises during the process of casting or in soldering; nausea and a feeling of oppression about the chest are the first symptoms, and afterwards colic and palsy, especially of the wrists. Workmen in white-lead manufac-



tories often suffer in the same way from inhalation of the fine powder of white-lead, chiefly from the beds in which oxidation goes on, and in the process of packing the product. And the same may be said of house-painters, to some extent, although lead-poisoning is more apt to occur in them from swallowing the lead compound in consequence of want of cleanliness whilst taking food. Operatives in tobacco-factories sometimes suffer very much from irritation of the throat, nose, and eyes, by the tobacco-dust, and there are some people who cannot become accustomed to an atmosphere of the weed. The greatest irritant effect appears to be produced in the manufacture of snuff, but with the large majority of operatives, if proper care and ventilation is secured, no very serious effects result after the first few weeks or months. Workers in mercury, artisans who silver mirrors, and those who handle the amalgam of mercury and gold, used for gilding silver articles in some cases, are very apt to be affected with a peculiar disease called mercurialismus. This complaint appears to be the result of the poisonous action of mercury upon the mouth, the teeth, the bones, and so forth.

Workmen who handle compounds of the poisonous metal, arsenic, in the manufacture of wall-paper, and women engaged in artificial flower-making where arsenical colors are employed, very generally suffer from the effects of arsenical poisoning in consequence of inhaling the dust of this dangerous metal.

Perhaps the most common kind of metallic poisoning from a metallic dust inhaled with the air, is that developed in persons who spend much time in rooms papered with arsenical wall-papers. In some instances, these brilliant yet treacherous decorations, which may be either green, purple, or brown in their color, have been found to contain as much as thirty-seven grains of the arsenical compound to the square foot, and numerous well-authenticated cases of serious injury to health from inhaling the atmosphere of rooms in which this arsenical dust was constantly floating, are on record. For example, Dr. Image states in the *London Practitioner* for February, 1880, that a brother and sister among his patients, whose ages were eight and seven years respectively, in consequence of an alteration taking place in the house, had their nursery changed. The walls of their own nursery were varnished, but the room in which they were temporarily placed was a smaller one, the ventilation was not so good, and it had not been papered for many years. After living in this room for a fortnight, they both began to suffer from inflammation of the eyelids, which did not yield to medical treatment readily, but which soon got well when they returned to their own room after the alterations were completed. On examination, the paper on the walls of the temporary nursery was found to have a white ground with bright, green flowers upon it, and these, on testing, gave evidence of containing a large quantity of arsenic. Hence, whenever a person who occupies a room

papered with green or purple hangings, begins without any obvious cause to suffer from headache, nausea, inflammation of the eyelids, dry cough, muscular tremors, and impaired nervous power, the cause should at once be sought for upon the walls of the apartment, and if the usual chemical tests show the presence of arsenic in a little of the coloring material which has been scraped off, both the patient and the paper should be promptly removed.

### **Dangers to Health from the Ground-Air.**

Although it is very common to consider the atmosphere floating above the earth as comprising the whole aerial element of our planet, from a hygienic point of view it is important to recognize the fact that a relatively small but absolutely large amount, called the ground-air, exists in the soil beneath our feet. By the experiment of displacing air from a weighed quantity of earth with water, it is easily proved that loose, dry loam may contain from thirty to forty per cent. of air. This, says Dr. Pettenkofer, is certainly a great quantity, and, incredible as it seems, such ground, as long as it is dry, actually consists of one-third air. In building upon gravel of this kind, we build also upon air, just as in some parts of Switzerland they build on water when they erect their houses on piles driven into swampy soil, and cut off below the surface-level. The ground-air is generally very impure, and there has been found in it as large a proportion of carbonic acid as in the worst ventilated human habitations. The amount of this impurity of carbonic acid is increased in proportion to the depth to which we penetrate within certain limits, and also to the proximity of that deep-lying layer of water called the ground-water, except during the months of June and July, when the upper stratum of the ground-air is most polluted with this gas. Ground-air may also be charged with many other impurities, such as emanations from decomposing animal matters contained in the soil. The air of burying-grounds, for example, is thus loaded with gases arising from the gradual putrefaction of bodies deeply interred in the earth, and it is important to remember that this ground-air may move with considerable rapidity through the soil, and be given off at long distances from the places where it first became polluted. Its passage through the interstices of the soil is governed by the usual laws in regard to the movement and diffusion of gases. Difference of temperature between the ground-air and the superimposed atmosphere leads to exchange and motion, and these fluctuations are constantly occurring. Such relative rise of temperature is often produced by the action of more or less vertical rays of the sun striking on soil of a darker color, and as the air in a certain spot or territory which is thus warmed expands and rises upward, its place must necessarily be supplied by cooler ground-air from surrounding localities, thus establishing currents through the earth, sometimes at great depths below the surface.

There is no doubt that in this way the germs of disease are carried by the ground-air for long distances, and being drawn into the cellars of furnace-heated houses, are poured out by the warm-air flues and registers into the midst of unsuspecting persons, especially children. Many mysterious outbreaks of infectious diseases, such as diphtheria and typhoid fever, have probably thus originated, and could easily have been avoided if the simple rule of supplying every furnace with a special cold-air flue, carrying pure air, were adhered to. This precaution will be fully elucidated in the section upon Healthy Dwelling-Houses.

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### CHAPTER III.

## THE HYGIENE OF FOOD AND DRINK.

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#### **The Necessity of Food.**

The sensation of hunger, which sometimes is or at least becomes, under certain circumstances, the most uncontrollable passion men ever experience, indicates, by the intensity of which it is capable, the almost infinite necessity of food for the body of man as well as of all animals. By its force, when we have long been deprived of food, we can measure the imperative nature of our wants in this respect; and the gratification all healthy persons enjoy in satisfying a keen appetite, is another sign of the importance of suitable nourishment to our bodies. On the other hand, what human being, except among infants, or those oppressed by abject poverty, has not suffered from indulgence in too great a quantity or an improper quality of food? Hence it becomes a matter of vital importance to the preservation of health, and indeed of life, that care should be taken to put into the stomach a suitable amount of properly prepared nourishment, of the right kind, and at proper times.

If each member of the human family was exactly like all the rest, it is obvious that a bill of fare could soon be arranged which would give every person the most perfect nourishment; but as we each differ, in some smaller or greater degree, from all others of our fellow men, it is necessary to study out for ourselves the problem of diet, as modified and limited by our own individual peculiarities and surrounding conditions of age, sex, exercise, habits of life, and so forth. On the other hand, the converse is



equally indisputable; that is to say, since taste, custom, and necessity render the varieties and amounts of food vastly different among the different individuals and nations of mankind, as a direct consequence of this variety in diet, some of the most important modifications of our race are produced. How wonderfully, says St. Hilaire, the great facts in the life of nations to which historians assign diverse causes, have really their origin at the firesides of the people among whom they are displayed. Consider, for example, Ireland and India. Would England have reigned peacefully so long over the distressed Irish populace if this latter did not depend almost entirely upon the potato, a vegetable nutriment, to prolong its misery? And across the seas, is it likely that a hundred and forty millions of Hindoos would submit so obediently to a few thousand Englishmen if they were fed like them? The Brahmins, like Pythagoras formerly, sought to soften the natural ferocity of mankind by feeding it upon vegetable aliments, and they succeeded, indeed, but at the expense of enervating the race.

### The Physiology of Nutrition.

An important preliminary to the useful consideration of substances which contribute to the nourishment of human beings, is the investigation of the office of food in the animal economy, and the mode in which it is converted into blood, and flesh, and bone. The study of our own and of living animal bodies teaches us that, during our whole lives, all the fluids, as well as the solid tissues of our systems, are constantly undergoing change. New materials in the form of infinitely minute particles of muscle, nerve, and so forth, are being produced, whilst the old and worn-out atoms of these structures are removed with ceaseless activity. And yet this incessant movement of these constituents of our bodies is not perceptible to the eye, even when aided by the most powerful microscopes; nevertheless it goes on, and must go on as long as life continues. In fact, the researches of physiologists tend to show, with a large amount of certainty, that the health, strength, and vigor of the whole and of every part of the body is in proportion to its youth and newness. Thus it is that exercise, under due regulation and management, is a hygienic means of such almost infinite value in strengthening as well as developing the whole frame, and especially the muscular system.

It is this inexorable necessity for replacing the loss of substance in our bodies which renders food the first great want of all created beings, without which continued existence is utterly impossible. Hence the subject of food has a claim upon our attention in accordance with nature's primary law, that of self-preservation, only second to the stern necessity which imposes upon us the need of securing a due supply of pure air for breathing purposes. The exaggeration, and therefore abuse, of this powerful natural instinct to seek physical nourishment *at all hazards*, and, if need

be, to the entire exclusion of every other thought and occupation, has in some countries, and in some epochs of our present civilization, been carried to such an astounding excess, that the accounts of it would be almost incredible were the supporting evidence any less conclusive.

In endeavoring to reach the "bottom facts" of our knowledge in regard to the forces we derive from the food taken into our stomachs, we must bear in mind that, in our own bodies, as in the whole universe around us, we have, from a scientific point of view, to deal only with material entities of various kinds and properties which we call *matter*, such as the chemical elements oxygen, carbon, or sulphur, and their compounds; and principles of action, which we denominate *forces*, among which may be instanced heat, electricity, and the attraction of gravitation, as types. The doctrine of the correlation of forces, abstruse as it sounds at first, is simply, as regards two of them, namely heat and mechanical motion, an extension of the commonly observed fact that motion, by causing friction, produces heat, as we see in using an ordinary Lucifer or friction match. Every time we strike a match we demonstrate that motion may produce heat; and to expand this idea into the doctrine of correlation (or relationship) of forces, it is only necessary to prove by careful and ingenious experiments, as was first done by Mr. Grove and Mr. Joule, that any certain amount of motion applied in any conceivable way to the production of heat, causes always exactly the same amount of heat; and contrariwise, a particular quantity of heat applied to the production of motion, originates always the same quantity of movement no matter by what kind of machinery it is applied.

In this way we can, by mechanical experiment, establish the existence of a correlation—or, to use the more familiar word introduced above, a relationship—between heat and mechanical motion, and this relationship has been found to be that the force of a weight of 772 pounds falling one foot would, if converted into heat, raise the temperature of one pound of water one degree of Fahrenheit's thermometer.

After clearly comprehending this idea, it is only necessary to grasp the further suggestion that, if a man is hired to lift up again the weight of 772 pounds, which in falling one foot gave us our unit of heat (namely, the heating of one pound of water, one degree), we further establish, by the additional experiment, a relationship or "correlation" between the number of muscular efforts he is required to make and that same heat unit.

Lastly, if we weigh the extra beef-steak or half-peck of potatoes he needs to eat, to enable him to perform so much extra labor, we find out the equivalent in ounces of food for the requisite amount of muscular exertion employed, which is again the equivalent of the mechanical motion produced, and this in turn is the equivalent of our (arbitrarily assumed) unit of heat the quantity of heat which will raise one pound of water one degree.

Thus even those readers who make no pretensions to scientific culture can, it is hoped, understand the nature of that mutual relationship or correlation which exists between these four natural forces, to wit, heat, mechanical motion (of falling or lifted weights), muscular exertion, and food.

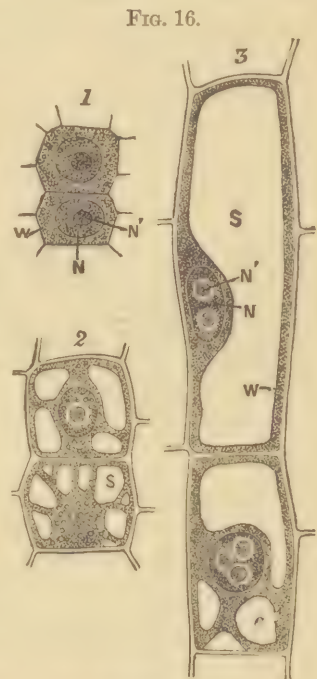
Food, then, is any substance which, when taken into the animal body, may enter into such new chemical combinations, that it gives out its dormant *force* in the form of heat, muscular movement, nerve power, and so forth.

If an article of food is completely combined with oxygen in the human system, it yields up all the force which it is capable of affording; but if it is not so adapted to the wants of the body as to be fully oxidized or burnt up, part of its force passes off with other refuse matters, and is wasted, as far as that man's nutrition is concerned.

It is by learning how to avoid this waste, as well as to escape the injury, excess of undigested food is apt to cause to the digestive organs, that a careful study of the articles of diet suitable for each individual, in accordance with the facts and conclusions detailed below, may be made so profitable and beneficial to every one.

According to the beautiful cell-theory of two German botanists (Schlieden and Schwann), all animals and vegetables are built up of minute, separate, organized bodies, called cells, which are put together like stones in a pavement, so as to form the skin, the muscles, the nerves, and so forth. This doctrine, which is now almost universally accepted, teaches that the cell-elements or cells are made up of a nucleus or central living mass, which may be aptly compared to the yolk of an egg. Around this nucleus is gathered a little lump of formed material or protoplasm, corresponding to the white of an egg, and the whole is enclosed in a delicate membrane resembling that which lines the egg-shell. These cells are extremely small, varying from one four-thousandth of an inch to one five-hundredth of an inch in diameter. In the epithelial scales or cells, which are packed together to form the skin, as already mentioned, the average diameter is about one fifteen-hundredth of an inch.

The marginal illustration shows the cells from the root of a plant magnified five hundred and fifty times. At 1 appear two young cells with

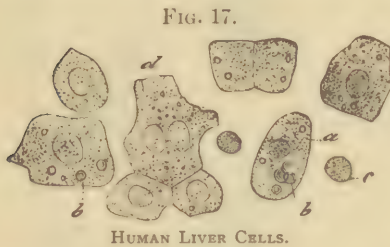


CELL-ELEMENTS OF A PLANT.



thin walls marked W, the nucleus N, and a central spot called the nucleolus N'. The protoplasm of each cell is seen occupying the space around the nucleus, and within the cell-wall. At 2 are exhibited a couple of older cells, with thicker walls, having vacant spaces or vacuoles, S, filled with fluid sap. At 3 are displayed still older cells, with a further decrease of the protoplasm, which has apparently been used up in building the yet thicker cell-walls. But although cells are thus seen to enlarge, the chief part of the growth of plant or animal is brought about by the multiplication of cells, which divide and subdivide sometimes with great rapidity. Besides increase of size of an animal by this multiplication of cells, we have differences of structure, resulting from variations in the form and composition of the fully-developed cells, such as those of the wood, bark, and pith of a plant, or the muscle, nerve, and skin of an animal. Lastly, by the death of larger or smaller groups of cells, are produced the decay of vegetable and the ulceration of animal organisms.

The different organs of human bodies and those of the inferior animals are built up of cells very similar to those found in the vegetable kingdom,



HUMAN LIVER CELLS.

as is illustrated by Fig. 17. This cut shows the liver-cells of man, with the nucleus, *a*, and oil-drops, *b*, in their protoplasm. At *c* is depicted a free nucleus, that is, one from which the cell-wall and the protoplasm have been accidentally torn away; and at *d* is shown a large cell with two nuclei, illustrating the tendency to occasional

twin-formation, which seems to run throughout all animated nature.

The first step towards the development of a new being in that wonderful yet hourly miracle of reproduction, as, for instance, of a young chicken inside an egg, is the division of the yolk into a great number of little rounded parts, which soon present the appearance of a heap or mass of cells, which for a time cannot be distinguished from the white cells in the blood of the parent hen. Gradually, however, as the operation of hatching progresses, certain groups of these cells vary under the influence of the vital force from other groups, until, by a continuing process of development, the liver, the heart, the skin, and so forth, are completely formed. In chickens, and birds generally, the young creature is nourished until large enough to pick up its own food by the contents of the egg; but in animals which bring forth their young alive, a curious natural provision is made for supplying the requisite nourishment from the blood of the mother. After birth, however, the necessity for food immediately becomes apparent, and in order that mere existence shall continue, external nourishment of some sort must be regularly supplied. Furthermore, if growth and complete development are to go on, this nourish-

ment must be accurately proportioned in kind, quantity, and composition to the exact needs of the infant animal or man.

### Hygienic Management of Infants' Food Vitrally Important.

It is probable that parents generally will more fully realize the importance of a scrupulously watchful care in regard to food if they are here reminded how necessary is strict attention to the diet of young children. No doubt, most readers have in their childhood reared from the seed some favorite plant, and as they saw the first frail shoot appearing above the ground have realized even in their youthful minds how a few drops less than sufficient water, an hour's too hot sunshine, or the assaults of some almost microscopic insect enemy, might easily kill the tender germ of this vegetable nursling, or cripple and dwarf its entire subsequent development; perhaps that a tiny pebble, if thrust against it rudely, might bend the feeble stem and render crooked or deformed what would otherwise grow into a stately tree. But the spirit of the axiom, "Just as the twig is bent the tree is inclined," is quite as true in regard to human and animal as it is respecting vegetable organisms, so that a variation of ten grains more or less of salt or sugar in an infant's food, five degrees of temperature in its bath, or a thickness of flannel in its clothing, may make the difference between life and death—nay, even between a hundred years of health and vigor and half a century of feebleness and deformity—to the sensitive organization of a new-born child.

Those who peruse this volume need scarcely be reminded that an immense amount of discussion, and even violent dispute, has been expended upon the question of whether animal or vegetable food is best suited to maintain the life of mankind. In most ages of the world, there have existed enthusiasts and visionaries, respecting this as in regard to almost every other subject, who have maintained that man was intended by his Creator to subsist solely on the fruits of the ground, without killing any of the animals which surround him, and that a purely vegetable diet was best adapted to support human life and health.

But it is easy to show from the Scriptures that, since the times of the Patriarchs at least, animal food has entered largely into the diet of the human race, and the evidences derivable from the form and arrangement of the teeth, the structure and functions of the alimentary canal, as well as the results of direct experiment, all indicate that, in the present age of the world at any rate, mankind thrives best, as a general rule, upon a mixed animal and vegetable diet.

One of the strongest and most obvious arguments against the theories of vegetarianism, is to be found in the constitution of milk, which, as everybody knows, was designed by nature for the entire sustenance of young infants, and, as a matter of daily experience, does fulfil its office as a diet for babies better than anything else that has ever been contrived.

By chemical analysis it is found that the substances containing nitrogen or azote (and hence called the nitrogenous elements of food), are largely represented in milk, by the compounds named albumen and casein, and these are the exact equivalents of meat, fish, and eggs; which, whilst they form so large a part of the world's food, would be ruled out of the bill of fare of a vegetarian as useless or injurious in their effect upon the animal economy.

It has been supposed by some that a very satisfactory method for deciding the proper proportions of animal and vegetable substances in our diet lists, would be to carefully analyze the milk of different animals, and so determine just what nature intended us to eat. If in this way we examine cow's milk, upon which so many young children thrive in every part of the world, we find that it is composed of

|                    |   |   |   |   |   |   |   |               |
|--------------------|---|---|---|---|---|---|---|---------------|
| Albumen and Casein | . | . | . | . | . | . | . | 54.05         |
| Butter             | . | . | . | . | . | . | . | 43.05         |
| Milk sugar         | . | . | . | . | . | . | . | 40.37         |
| Salts              | . | . | . | . | . | . | . | 5.48          |
| Water              | . | . | . | . | . | . | . | 857.05        |
|                    |   |   |   |   |   |   |   | <hr/> 1000.00 |

But in arranging a bill of fare according to this table, it must not be forgotten that a milk diet is intended for a child or young animal, which is rapidly growing and adding to the size of its body, whilst it expends in labor comparatively little muscular force; so that, whilst it really forms an admirable diet for a young infant, it is not necessarily the most healthful or most advantageous combination of alimentary substances for the food of an adult woman or man. For such a full-grown individual, better results may be obtained by accurately determining, as has been done by scientific men, the quantities of the chemical elements carbon, hydrogen, nitrogen, and oxygen, which are cast off from the body by the bowels, the kidneys, the skin, and the lungs, every twenty-four hours, and then calculating what quantities of various articles of food, containing these chemical elements, must be eaten daily to supply this waste.

For instance, if we find, as some English investigators have done, that a gang of one hundred average prisoners cast off every twenty-four hours, from their lungs, kidneys, and bowels, about seventy-one and a half pounds of the element carbon, and four and a quarter pounds of nitrogen, it is obvious that carbon and nitrogen must be supplied to this amount in the food the gang of prisoners eat, in order to make up for what is excreted. If they were to be fed upon bread and water alone, it would require 380 pounds of the staff of life daily, to keep them in good health, because it requires that weight to yield the four and a quarter pounds of nitrogen which they daily cast off in the ways just mentioned. But in 380 pounds of bread there are 128 pounds of carbon, which is about



fifty-seven pounds more than would be needed to replace what these men would excrete. On the other hand, should the authorities try the experiment of giving them animal food only, it would be necessary to allow them 350 pounds of lean meat, because no less than that amount would contain the seventy-one and a half pounds of carbon necessary to replace the quantity of this element excreted; but lean meat contains proportionately a very large amount of nitrogen, and in 354 pounds of it, there would be found 109 pounds, or 105 pounds nearly in excess of what the prisoners really required, and which would therefore be wasted as food. In the former case which we have supposed, each man would have to eat about four pounds of bread, and in the latter about three and a half pounds of meat every day, in order to avoid losing strength. In the first instance, there would be a good deal of starch in the bread, and in the second case, a considerable bulk of nitrogenous material, which would be quite unnecessary as food, and apt if taken into the stomach to overload it and derange its functions. The true way is to resort to a mixed diet, and if such were to be adopted in this instance, we would probably find that 200 pounds of bread, with sixty pounds of meat, would answer every purpose. Two hundred pounds of bread contain, besides water, sixty pounds of carbon and two of nitrogen, and sixty pounds of meat about twelve of carbon and two and a quarter of nitrogen; making, it will be observed, exactly the quantity of each of the primary elements cast off by the 100 men daily as waste matter from the processes of life.

It is manifest, according to this calculation, that milk is not accurately suited to supporting an adult population, because it contains too little carbon and too much nitrogen to supply the waste. This excess of nitrogen is well suited to the young animal which is actively engaged in adding to its muscular development, but is not adapted to the full-grown man, who is obliged to produce force, or its equivalent, heat, by the slow combustion of carbon in his body. It is to supply this excess of carbon, beyond what exists in milk, that all the world over bread or starch which is rich in carbon, in some form, is gradually added in larger and larger proportions to the food of a growing child.

Such calculations, in regard to the other constituents of our food, form a basis of the utmost value for the economical arrangement of diet lists, and the distribution of limited means, as, for example, in armies and navies, with the least possible waste of the ingredients at command.

The variety of articles of human diet is very great, for by his structure and organization man is practically omnivorous. He can draw his nourishment from all three of the kingdoms of animated nature, and if compelled he can, in the wasteful way just described, support existence—for many months, at least—upon an exclusively animal or vegetable aliment. But the diet which is best suited to his needs is that in which meats and vegetables are associated in a proportion varied according to age and

climate, but especially according to the amount of work or exertion which he wishes to accomplish.

A natural law, says Liebig, prescribes that the human being should derive his nourishment in certain definite proportions from among the nitrogenous, such as meat, and the non-nitrogenous articles of diet, and these proportions cannot be changed by misery or by poverty without injuring the health of man, or endangering the activity of his physical and intellectual powers. Different articles of diet may vary greatly in regard to their capacity for producing and reëstablishing the force and energy of mankind. Thus, for example, bread made from wheat is superior to rye bread; rye bread in its turn is better than boiled rice or potatoes; whilst meat is more valuable than any other food of equal weight. Nothing serves to repair the muscular forces when they are exhausted by over-work so rapidly as animal flesh. Carnivorous animals are generally stronger, more enduring, and more courageous than the herbivorous creatures upon which they prey; and the same difference may be observed in nations which subsist chiefly upon vegetables as contrasted with those whose diet is largely composed of meat.

### The Digestion of Food.

The disturbances of digestion and assimilation, constituting dyspepsia in all its varied and distressing forms, which sometimes make life almost unendurable, can only be properly understood and guarded against by knowing just how all the digestive processes are properly accomplished. The first step in the wonderful operation of converting an article of diet, as, for instance, a piece of bread, into a constituent part of the human body, is that of chewing. This is performed by the aid of the teeth, and this being the only portion of the whole process which is directly under the control of the will, merits on that account special attention. The chief agents by which chewing is accomplished are the teeth and the tongue, although the muscles of the cheeks have also an important share in the process.

### The Teeth.

In the adult human being the teeth, when perfect, are thirty-two in number, and are arranged in the following order: First, in the middle of each jaw, are the four incisors or cutting teeth; next, come one on each side of the group of incisors, the two canine or dog-teeth, so called because they are very large and conspicuous in a dog's mouth; the next pair of teeth, situated just back of each canine tooth, are named the first and second bicusps, on account of their having two points or cusps; behind these, again, we find the first, second, and third molars, or grinding-teeth. The last, or third molars, four in number, counting two in each jaw, of course, have received the name of the wisdom-teeth, because they appear about



the time that people grow up and are supposed to have arrived at years of discretion. The permanent teeth are preceded during childhood by a smaller set, only twenty in number, which are styled the deciduous teeth, for the reason that they fall out or are pushed out by the larger and stronger permanent set. These deciduous teeth begin to come through the gums of babies when they are from six to twelve months old, and unfortunately give rise to much of the pain endured in childhood. Later in life, the gradual decay of the second set renews suffering, and even after the natural teeth are substituted by artificial ones, the discomfort these often cause fully justifies the old saying, that the teeth are a trouble to us from the cradle to the grave, especially if scrupulous hygienic care is not taken of them.

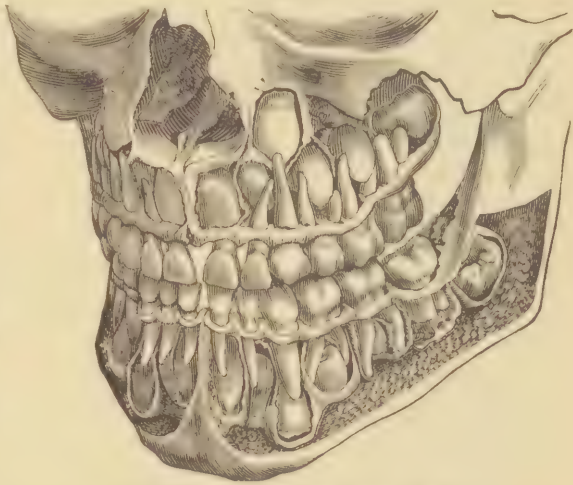
Fig. 18 shows how the second set of teeth comes in behind the first, or deciduous teeth, pushing these latter out of the jaws from the sixth to the tenth or twelfth year of life. Each tooth has, as

can be readily seen by cracking open one from a dead animal, a very hard outside shell, composed of what is called the enamel, a softer and thicker body-substance, denominated dentine or ivory, and a hollow place near the centre of this dentine, named the pulp-cavity, which during life is filled with a mass of nerves and blood-vessels.

The pulp or nerve of a

tooth is exceedingly sensitive, and acutely painful on the slightest touch, or even from mere exposure to the air, as, for example, by the breaking off or decaying away of some portion of the dentine or tooth-bone which naturally protects it. The horrible agony of toothache is thus caused, and the hygienic prevention of such suffering is simply to avoid the decay as long as possible by keeping the teeth clean, refusing corrosive articles of food or medicine, and, when cavities begin to form, having them stopped up or filled by a skilful dentist before they have time to reach the nerve. Whilst frequent cleansing of the teeth is important, it is not advisable to brush them too much with hard tooth-brushes, and especially with gritty tooth-powders, thus irritating the gums and wearing away the very enamel which it is our object to preserve. The teeth should never be used to break hard objects, nor employed as nut-crackers, scissors, pincers, monkey-wrenches, chisels,

FIG. 18.



THE DECIDUOUS AND PERMANENT TEETH.



or other carpenters' tools. Hot and cold liquids, especially in quick succession, ought not to be brought in contact with them, as in drinking; and strong vinegar, syrups, and sweetmeats ought likewise to be kept away from the teeth. If candies are eaten at all, or at rare intervals, the sugar remaining between the teeth and around the gums should be promptly washed away by rinsing the mouth.

### The Tongue and Salivary Glands.

Besides being the organ of taste and the chief agent in the production of speech, the tongue performs an important duty in bringing different portions of a mouthful of food under the molar teeth during the operation of mastication or chewing. This office of the tongue is shown to be one of great usefulness, by the fact that, in the disease called palsy, where the power of moving the tongue is impaired or almost lost, the patient often finds great difficulty in chewing his food at all, simply because he is unable to push it between the grinding surfaces of his back teeth. But breaking up the food into a sort of coarse powder is only a part of the first step in its proper preparation for digestion in the stomach, and to make it quite ready it must be mixed with the liquid of the mouth, called the saliva, which has the remarkable power of turning the insoluble starch of bread and other starchy foods into soluble sugar. The salivary glands, whose business it is to manufacture the saliva, are six in number, four being situated under the tongue and the jaw, and the others seated deeply in the cheeks in front of the ears. These are called the parotid glands, and are remarkable for being the parts affected by the contagious disease named mumps, which is sometimes so painful that it is quite worth while to use careful hygienic precautions against contracting it by touching or inhaling the breath of a person sick with the disease. The saliva is poured out by different ducts, into various parts of the mouth, so as to become intimately mixed with the food. Its active principle, named ptyalin, plays a very important part in the digestion of the amylaceous substances, that is to say, articles of diet, such as bread, potatoes, corn, and the like, which are chiefly composed of starch. It is, therefore, highly necessary that chewing should be performed slowly enough to give time for a sufficient quantity of saliva to be secreted, and to be completely mixed with the food, as want of care in eating too fast is apt to be followed by that terrible punishment for every neglect of hygiene in regard to diet, the disease called dyspepsia, as already mentioned. It is difficult to urge too strongly the immense importance of a thorough mastication of vegetable food. In the human being, the saliva is produced in the quantity of nearly four pints daily during health; but the secretion of this very important agent in the digestive process is powerfully affected by mental emotions, such as fear, anger, or pity, and it is also largely influenced by certain medicines, such as belladonna or deadly nightshade, even in comparatively small doses.

### The Hygiene of Swallowing.

The entire process of swallowing is a series of associated muscular acts, quite independent of the force of gravitation, as may be seen in animals drinking with their heads downwards. Although these complex movements follow each other without any check or pause, it is common to divide them into three stages, the first of which is the voluntary one of pushing the mass of chewed food back to the upper part of the throat or pharynx, so that it is grasped by the involuntary muscles, which send it on downward to the stomach. This operation the muscles which form the tube called the throat or gullet accomplish by relaxing in front of the morsel of food which is being swallowed and contracting behind it.

Fig. 19 exhibits the deep muscles of the cheek and the pharynx with adjoining parts. The circular muscle of the mouth (1) and the buccinator or trumpeter's muscle (2) help the tongue to push the food back to the upper margin of the gullet, where it is seized upon by the three constrictor muscles (3, 4, and 5) of the pharynx, and pushed down the gullet or œsophagus, which is represented as being cut off at 6.

In front of the pharynx is an opening into the windpipe named the glottis (see Fig. 11), through which we breathe, but which must, of course, be closed during the operation of swallowing, in order to prevent our food from dropping into it. This closure is effected by the ingenious contrivance of having a broad, thin piece of gristle, or cartilage, as anatomists call it, hinged like a trap-door, so as to shut down over the glottis in such a way that no particles can pass through it and irritate the windpipe, or the lungs, which communicate immediately with that tube. But if we imprudently attempt to cough, speak, or laugh, whilst in the act of swallowing, this careful provision of nature to prevent choking is rendered useless, because we open the trap-door just at the wrong time, and some fragments of food are apt to pass through the glottis. When this happens, the food particles coming in contact with the very sensitive mucous membrane they find there, bring on the sharp pain and violent coughing, characterizing what is popularly called "swallowing something the wrong

FIG. 19.



THE SWALLOWING MUSCLES.

way." Very often the sudden cough thus set up answers the purpose for which it was doubtless intended, and drives out the offending bits of food; but if these particles are heavy, hard, or sharp-cornered, they may stick fast in the windpipe, producing great suffering, or they may even work their way down into the lungs and set up fatal inflammation of those organs. In such a case death would be the strictly just, but terribly severe, punishment for violation of a hygienic law of nature, that we

must keep this little trap-door, the epiglottis, closed whilst we swallow.

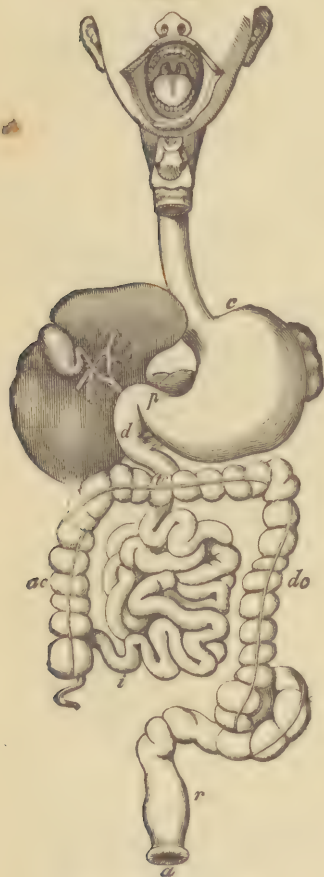
The gullet or œsophagus is a muscular and membranous tube, about nine inches long, which if dissected out would look very much like a thin piece of rubber hose, such as is used for watering gardens. Its duty is to carry the food from the pharynx to the stomach, and in order that it may not get stopped up by food getting wedged in it, this pipe, in consequence of its muscular structure, has the power of contracting itself in successive portions from above downwards, so as to push onward the articles of diet which are being swallowed. In both the mouth and the gullet goes on the change of starch into glucose, by the action of the saliva; and as this important alteration is checked or altogether stopped in the stomach, the fact forms a most cogent additional reason for eating slowly, and retaining vegetable food, at least, for a long time in the mouth and throat.

#### The Stomach and its Duty in Health.

The human stomach is a somewhat egg-shaped bag, the walls, as the substance of the bag is called by anatomists, of which are made up first, counting from the inside outward, of a layer or coat of mucous membrane

which is similar to, and continuous with, the moist red mucous membrane which we see lining the mouth and throat. Outside of this is a coat of muscular fibres, some running around and others diagonally across the sack, and then outside of these again is a layer of membrane or skin. The stomach communicates, at its upper part on the left side of the body just below the heart, with the gullet which opens directly into it, *c*, and it empties itself, on the right side, into the upper portion of the small intestine, through a sort of valve, *p*, which has received the name of the pyloric orifice, because the word pylorus means a janitor or gate-keeper.

FIG. 20.



THE ALIMENTARY CANAL.



The arrangement of the stomach and other portions of the digestive apparatus, or alimentary canal, or alimentary tract, is well shown in Fig. 20. The stomach is shown as if pulled over toward the left side of the body, and a little less directly transverse than is natural; the liver is turned up so as to display the gall-bladder on its under side, and the small intestines, *i*, are grouped together instead of lying in a confused mass with the large intestine or colon, *ac*, *tc*, and *dc*; but making allowance for these modifications, which are represented in order to render the picture clearer and more comprehensible, the illustration is a very accurate one.

The whole of the mucous membrane, or inner lining of the stomach, is filled with glands, somewhat similar to the salivary glands, but so small that they can scarcely be seen with the naked eye. These glands all open into the cavity of the stomach, and their business is to manufacture, from the blood which flows around them, in a network of fine blood-vessels with very thin walls, that important fluid, the gastric juice, remarkable for having such a wonderful solvent power upon the meat, eggs, and so forth, which constitute what is denominated the nitrogenous portion of our diet. This gastric juice is a sour liquid, containing the curious substance named pepsin, and upon its production in proper quantity, and of the best quality, the successful digestion of food, and therefore the health and well-being of the whole human body, largely depends. Little or no gastric juice is produced when the stomach is empty, as is generally the case before a meal; but as soon as food is swallowed, the active little glands, studded all over its lining mucous membrane, set to work and pour out the digestive liquid. At the same time, the muscular coat of the stomach is also busy, and the several portions of the organ undergo successive contractions, which are somewhat like those visible in a large earth-worm as it crawls over the ground, and which have the effect of moving the soft and pulpy food inside along from end to end, and churning it round and round in such a way that it is thoroughly mixed with the gastric fluid, and acted upon in every part of its entire mass.

A very important hygienic rule is founded upon this circumstance, namely, that since any excessive bodily activity or disturbance of the mind interferes both with the muscular movements of the digestive organs and the secreting power of their glands, in order to have the digestion of food go on to the best advantage, we ought to avoid any violent exercise, mental excitement, or severe study, at or soon after meals.

The quantity of gastric juice very much exceeds that of the other digestive fluids, it being poured out to the amount of about twelve pints or a gallon and a half every twenty-four hours. Its office is to dissolve the muscular fibre of meat, the albumen of eggs, and so forth, as well as the capsules of starch corpuscles, and some other vegetable ingredients of food.

The third of the digestive fluids is the bile, which is secreted by the liver, and poured into the upper part of the small intestine to the amount of nearly four pints every twenty-four hours. The functions of the bile are not very well understood, but it is certain that it has important duties to perform in neutralizing the acid gastric juice, after that liquid has accomplished its work on the nitrogenous constituents of food, and also in promoting the action of the bowels, and so preventing constipation. This whole subject of costiveness as a result, and a lamentably common one, of torpor of the liver, and a consequently insufficiently formed secretion of bile, will be explained more fully when speaking of diseases of the liver and bowels. Although, as before remarked, the precise action of the bile in digestion is unknown, it is evident that the function is a very important one, not only from the fact that such a large quantity as half a gallon is secreted daily, but also from the effects upon the system of diseases of the liver, like cancer of that organ, in which the formation of bile is diminished or completely suppressed. A certain portion of the bile is accumulated in the gall-bladder, a strong membranous bag, situated in a groove on the under side of the liver, as shown in Fig. 20. It empties into the small intestine through a slender tube, the gall-duct, which, from a medical point of view, is chiefly important on account of the horrible agony produced when it is traversed by the gall-stones, sometimes formed in the bladder whereof it is the outlet.

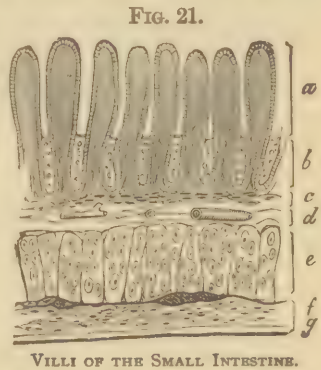
The fourth liquid concerned in the important operation of digestion is the pancreatic fluid, which is secreted by the pancreas in the amount of about a pint and a half daily. The pancreas is a long, thin gland, situated behind the stomach, and constituting, in the ox, part of what is sold under the name of sweetbread. The office of the pancreatic juice is to aid in dissolving the starchy materials of our food, and also to emulsionize, as it is called, the fatty ingredients, and thus render them absorbable from the intestines with the other alimentary substances.

The fifth and last of these digestive fluids is the intestinal juice, the duty of which appears to be simply to supplement the action of the others. As indicated by the small amount in which it is secreted, which is only about half a pint in twenty-four hours, it is much less important than the rest. This fluid is produced in the small intestine, a membranous pipe or tube about twenty feet long, but twisted and looped together in such a way as to occupy only the small space of a few inches in the cavity of the abdomen, which forms the lower half of a person's trunk, or body as it is often called, in contra-distinction to the limbs and head. This tube is continuous with the pyloric opening of the stomach at its upper end, and at its lower extremity empties, as shown in Fig. 20, into the side of a much wider membranous tube, about five feet in length, called the large intestine. Most of the large intestine has received the name of the colon, and it may be justly compared to the main sewer of a



city, into which pass all the waste refuse and foul materials which are of no further use, and must be gotten rid of as soon as possible. The neglect or failure for any reason to properly and regularly empty this great sewer of the human body, constitutes the disease called constipation, and is probably one of the commonest causes of ill-health in civilized countries. The whole of the small intestine grows slightly narrower from its commencement at the stomach to the place where it joins the large intestine. This narrowing of the intestinal tube, through which all the indigestible matters which we swallow must pass, in order to escape from the body, is a very important fact to remember when we are tempted to hold in our mouths, and so run the risk of swallowing, coins, pins, stones of fruit, and other hard or angular objects, because they might easily stick fast in the small intestine, obstructing the channel of the alimentary canal, and causing almost certain death.

The whole intestinal tube is lined with a mucous membrane, and in the small intestine this has its inner surface covered with hundreds of thousands of little tongue-like projections called villi. These villi are represented as they appear when highly magnified in the marginal illustration, which is a diagram of a thin slice cut lengthwise from the wall of the tube. At *a* are shown the villi, which during life are constantly waving backward and forward, in the half-liquid, semi-digested food which flows over them, and lick up what they can of the nourishment it contains, which they absorb into their substance and transmit to the blood. At *b* is seen a row of little glands; *d* indicates the basement-membrane of the mucous coat; *e* the fibres of the circular muscular coat, and *f* the longitudinal muscular fibres.



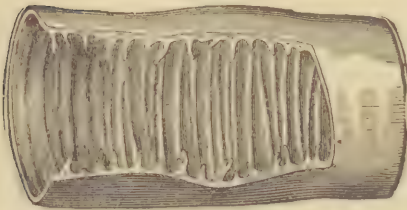
These two layers of circular and longitudinal muscular fibres are during life in constant motion, in successive segments or rings, almost in the same way as are those of the stomach, and for a similar purpose, namely, to push the semi-fluid digested food, or chyme, from the upper to the lower end of the small intestine. This constant motion of the intestine is so much like that of an earthworm that it has been called the vermicular movement; but it is more generally denominated the peristaltic motion. It can probably be most conveniently seen in the intestine of a chicken, soon after it has been killed, and even so long subsequent to the death of the bird that this vermicular motion has stopped, it may sometimes be renewed if the carcase is not cold, by touching or gently pinching the small intestine. Under such circumstances, a wave of contraction passes from the stomach down along the bowel, so as to look like a broad



ring of constriction passing slowly downwards. The longitudinal fibres at the same time contract, so as to shorten the piece of intestine immediately below the ring of constriction, and also to cause a sort of rolling motion of those loops of intestines which are free to move. This motion takes place at shorter or longer intervals, according to the amount and kind of food in the bowels, provided the intestinal canal is duly supplied with good rich blood, and all the apparatus is in a proper and healthy condition. The vital necessity of its complete performance, as a means of keeping the alimentary canal from being stopped up by accumulations of undigested or only partially digested food, is so obvious that it need scarcely be insisted on.

Although the intestinal canal is so prolonged as to measure, when stretched out, over twenty-five feet,

FIG. 22.



THE VALVULE CONNIVENTES, OR FOLDS OF  
THE INTESTINE.

stretched out, over twenty-five feet, its internal surface is not sufficient to perform all the work of absorbing the digested materials of diet. Hence, the lining mucous membrane is thrown into folds, as shown in the appended woodcut, simply in order, it appears, to afford surface enough for absorbing all the nutriment from articles of food, and so

disposing of the substances we swallow to the best and most economical advantage.

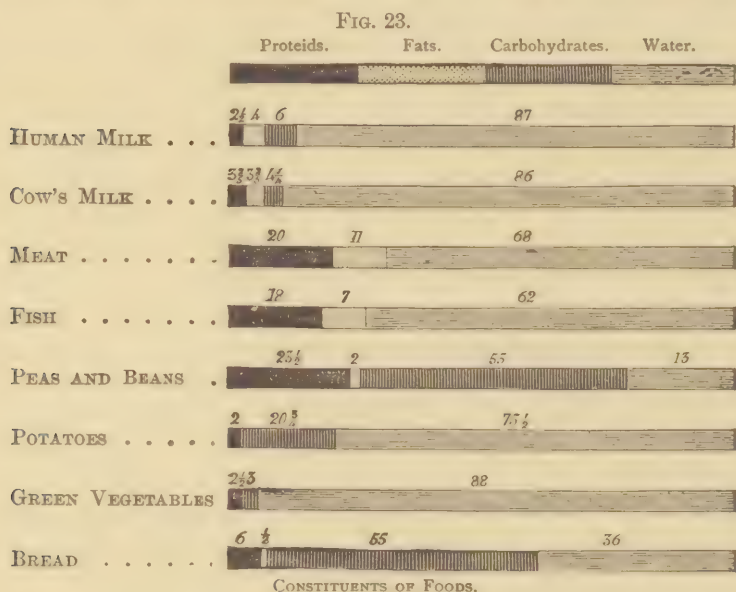
### Classification of Foods.

Baron Liebig long ago divided foods into the respiratory, or those which are burned off in the system by the aid of the respired air to maintain the heat of the body, and the plastic, or those which go to form the tissues of the body in the economy of nature. Although this classification is not strictly correct, it is worthy of remembrance on account of its simplicity and value as a general guide respecting the uses of food. A better classification is into four groups, as follows: 1st. The nitrogenous substances, or proteids, which go to form the tissues of the body, and are represented by meat, eggs, the casein of milk, and other substances consisting chiefly of albumen. 2d. The fatty or heat-producing aliments, which are derived from both the animal and vegetable kingdoms, although chiefly from the former; they include the animal fats, such as lard or suet, butter and the vegetable oils, among which that from the olive is the one most consumed by civilized man. 3d. The carbo-hydrates, or substances containing carbon and hydrogen without nitrogen; these are the saccharine or sugary, and the amylaceous or starchy ingredients of human diet, comprising therefore sugar and molasses, and also the starch which makes up the chief bulk of bread, potatoes, beans, etc., and which

is converted into a kind of sugar during the process of digestion. 4th. The saline or salty articles, consisting largely of common kitchen salt, with potash, lime, magnesia, and a little iron in various combinations. These ingredients of the human body, small as some of them are in amount, possess a very great importance, from a hygienic point of view, which has probably never fully received the attention which it deserves.

Each one of the numerous chemical elements in these various constituents of our food, may be looked upon in its relation to a perfect human body, like the pieces of a dissected map, the smallest of which cannot possibly be replaced by any of the rest, and if missing from its appropriate place, destroys the completeness of the whole wonderful design.

Experiments upon a large scale and varied in a great many ingenious



ways, which it would take up too much space to describe here, have proved that a workingman of average size, that is, weighing about one hundred and forty pounds, requires every day nearly a pound of meat, eggs, or other proteid food, about four pounds of starchy and saccharine aliment, comprising bread, potatoes, vegetables, and sugar, nearly a fourth of a pound of butter, lard, or other fat, and an ounce of saline materials of various kinds. This is, of course, besides water, which most grown people drink to the amount of from one to three pints daily, and constitutes altogether the amount of necessary nutriment required to enable an average-sized man to do moderate work in a temperate climate, without losing strength and health.

The above instructive diagram (Fig. 23) shows the percentage of the different nutritious elements of food in eight of the common articles of

diet. The numbers indicate the parts by weight in every hundred, the nitrogenous matters, or proteids, as they are also called, being represented by the black portion of each bar; the fats by the dotted section; the carbohydrates, under which title the saccharine and starchy materials are grouped, by the part shaded with vertical lines; and the water by that division marked with horizontal lines. In order to render the comparative value of these food-stuffs more obvious, the indigestible ingredients are not represented.

It is to be observed that much of the water we require is, as the table shows in regard to milk and green vegetables, taken into the system associated with the more solid articles of diet. Therefore, as each of these food-stuffs may vary exceedingly in regard to the water it contains, it is necessary, in making any accurate calculation, to reckon it on the basis of their being entirely free from moisture. Of such perfectly dry, or as Dr. Parkes calls it, water-free food, an idle man would require only about twenty-three ounces. In this there should be four and a half ounces of the proteids, three ounces of fats, fourteen and a half ounces of starchy and saccharine matters, and nearly one ounce of salines. The amount of food suitable for persons under or over the average weight, is to be calculated by a simple sum in proportion, bearing in mind, however, that rapidly-growing young people require more, and obese persons, whose bulk is largely made up of inert fat, need less than the formula would indicate. For example, a slender lady of short stature, weighing seventy or eighty pounds, might be kept in fair health and strength by about half the nourishment just suggested, whilst an actively-developing boy of the same weight would perhaps require three-fourths or even nine-tenths of the quantity of food mentioned. A child of five years old, who would perhaps weigh one-fourth as much as an average-sized man, ought to eat nearly one-third of a pound of meat, a pound at least of oatmeal, potatoes, bread, and molasses, and so forth, rather more than an ounce of butter, and a quarter of an ounce of saline matters, including, of course, the salt it takes in meat, milk, and other articles of diet.

When men are called upon to perform any extra amount of severe labor, involving great muscular exertion, there is no doubt that an additional supply of meat is of great service. One of the speakers at the French Hygienic Congress of 1878, emphasized the value of animal—that is, nitrogenized—food in enabling men to accomplish more hard work, in a curiously impressive manner, as follows: “Remember,” said he, “the workmen at the forges of Tarn, who, whilst fed upon a vegetable food, lost—every man of them—on an average fifteen days’ work annually; but when they were placed upon a meat diet, lost only three days per year through illness. Recollect, also, the English workmen employed in building the railroad from Paris to Rouen, who, being fed upon roast meat, accomplished one-third more work than the French workman did



upon their diet of soup and leguminous articles of food. Recall, too, the forges of Ivry, which when first founded had to be supplied with operatives from England to do the heaviest work, until the day when certain French workmen, being fed upon the same animal diet, acquired the same vigor and the same endurance." When Frenchmen thus admit a physical superiority in the natives of their hereditary foe, perfidious Albion, one can scarcely doubt that such superiority really exists, and there seems every reason to believe that it is due to the cause assigned by M. Bouley. An important practical conclusion to be drawn from these remarks is that any one who is called upon to perform some great feat of strength and endurance, should fortify his muscles before, and reinforce them afterwards, by eating abundantly of animal food, without, of course, overloading his stomach and associated organs with more than they can digest, because that would defeat the very object for which the extra amount of food was employed.

In regard to the functions of the fatty constituents of food, we may at once conclude that, since the diet resorted to by inhabitants of cold countries invariably contains a large proportion of fatty ingredients, these elements play an important part in the maintenance of animal heat. Indeed, it has been demonstrated by experiment that the respiratory or heat-producing powers of fat are two and a half times greater than are those of the vegetable hydro-carbons, such as starch or sugar. Fat also takes an active share in the conversion of food into tissue, and is believed to aid in the removal of the used-up materials from the system. Among the mechanical uses of fat, after it has been deposited in various parts of the system, may be mentioned that it gives roundness to the form, aids in retaining the heat of the body by virtue of its being a comparatively poor conductor of caloric, and very much facilitates the operations of the living machine in all its various parts, by diminishing the amount of friction and deadening the shock of falls or blows, in consequence of its elastic properties.

The saccharine and starchy constituents aid the fatty matters in developing animal heat, although they are much less efficacious in this respect. Starch is, however, capable of being rapidly converted into fat by the wonderful operations of nature's laboratory, as we see in the process of fattening pigs upon corn for market, and in this way a large store of the best heat-producing material may be laid up in the system as a provision for the winter's cold. Western hunters tell us that the bears, which, after feeding upon the autumn nuts and fruits, go into their winter quarters to hibernate during the cold season fat and plump, come out in the spring wasted almost to skin and bone, and looking like the mere shadows of their former selves.

The relative power of the stomach in digesting the different kinds of food and drink swallowed into it, was for centuries a mystery to physiolo-

gists, and it was only about sixty years ago that it was first found out exactly what happens to articles of diet after they pass out of sight down the œsophagus. In the year 1825, Dr. Beaumont, of the United States Navy, enjoyed the opportunity of examining a young Canadian named Alexis St. Martin, who had been accidentally shot in the left side, so as to leave a hole, when the wound healed up, communicating with his stomach, in such a way that any one could look in and see what was going on there. Much of our knowledge about the comparative digestibility of foods of different kinds, has been obtained from experiments made upon this man, who is said to have earned a comfortable living for years by going round the world and allowing his wonderful open stomach to be examined and tested in various ways by scientific men. Some of the important truths first discovered in St. Martin, and afterwards confirmed by observations upon other persons and upon animals, are as follows: Liquid, such as water, both pure and when containing a small amount of nutriment in solution, as is the case with beef-tea or broth, are often quickly absorbed by the lining membrane of the stomach, very much as water is sucked up by a sponge, and pass directly into the blood. It is probable that, as a general rule, fluids of this sort are taken up within half an hour or an hour after they are swallowed. Milk is usually coagulated or clotted as we see it when curdled by rennet, which is the dried stomach of the calf, by one of the ferments in the gastric juice, but it is commonly soon dissolved again and absorbed. Wheat-bread composed, as already mentioned, chiefly of starch, cannot be regarded as holding a place among the quickly digestible foods, since it has been found to require nearly three hours and a half for solution. It was proved to be decidedly more wholesome when a day old than when fresh baked and hot. If it forms too large a proportion of the diet, it is apt to lead to constipation, with all the terrible injuries to health thus produced in the system; and as this tendency is partly corrected by bran-bread and bread made from the so-called Graham flour, many people learn by experience that the latter varieties of the "staff of life" are better suited to their bodily needs. Hot cakes of different kinds are less wholesome than stale bread, but habit sometimes enables the stomach, whilst in its best state, to digest them without apparent injury. Boiled dough, such as is inflicted upon unfortunate members of the human family in the shape of plum-pudding, dumplings, and such like contrivances, is particularly unwholesome. Eggs, if eaten raw, may be digested in two hours, but if boiled soft may take three hours, and if hard boiled or fried, require three and a half hours for digestion. Meats of various kinds differ a good deal in their digestibility; thus, for example, boiled turkey has been found to disappear from the stomach in about two hours and a quarter: boiled lamb in two and a half hours, and roast beef in three hours: whilst fried pork requires over four hours, and roast pork five hours and a quarter for complete digestion. Fish prove, as a



rule, more easy to digest than meats; and the ordinary vegetables present less difficulty to the action of the stomach than bread, boiled rice being particularly manageable and requiring only about an hour for its entire solution. It must be recollected, however, that these observations are valuable to us only in a general way, since digestion varies very much, not only in different persons, but also in the same person according to the amount of exercise, exposure to heat and cold, habits of life, and so forth. Rules founded upon them are besides subject to many exceptions, because most people have some certain peculiarities, or idiosyncrasies, as they are called, in regard to diet, being made sick by an article which usually proves wholesome, such as an egg, whilst they are perhaps able to eat without ill-effects some kind of aliment which is generally accounted indigestible. Such peculiarities can only be discovered by experience, and as it is very important to learn just what they are early in life, it is wise for even children to be taught carefully to notice and remember, what particular articles of food agree, and what ones disagree with their individual stomachs.

#### The Assimilation of Food Following Digestion.

In order that the food-stuffs, when altered by the various processes described as being portions of the digestive process, may be of any real use to the animal economy, the nutritive materials must be distributed through the different tissues and organs of the body. The mere digestion of food is by no means sufficient, and no matter how much we eat, we might just as well expect a locomotive to run well without the wood supplied to it being burned under the boiler, and the water heated to furnish steam for driving the machinery, as to hope that the meat and potatoes we eat would accomplish anything toward keeping our muscles, hearts, and brains in active operation, unless food-elements were absorbed after digestion into the blood, and assimilated from it into the very structure of all the different portions and organs of the animal frame.

It was formerly believed that the blood-vessels directly absorbed the nutrient elements of food after its digestion, but the discovery of the lymph- and chyle-vessels led the way to a more correct understanding of the process of absorption. As shown in the following illustration (Fig. 24), the lacteals, *LAC.*, which take their origin in the villi of the small intestine, converge and unite together, meeting the combined lymphatics of the lower extremities in a kind of bag, called the receptacle of the chyle, *R. C.*, which is situated deeply in the abdomen and in front of the spine, near its middle. From this the mingled chyle and lymph are carried along the thoracic duct, up to the root of the neck on its left side, where they are poured into the large veins, and so mix with the blood and become a part of that vital fluid. The lymphatic vessels, including the thoracic duct, are furnished with a great number of valves, by which their fluid contents are forced forward toward the heart, when pressure is made upon



the vessels by any contracting muscles. The lymphatics are also supplied with numerous glands, the office of which seems to be to filter out certain impurities which might otherwise prove exceedingly injurious to the organism. These glands likewise have important functions in the preparation of the blood corpuscles, but the exact method in which this is performed is not fully understood. The quantity of fatty matter in the lymph in visible particles, diminishes as it passes along toward the opening of the thoracic duct into the subclavian vein, so that a further stage

FIG. 24.



THE LACTEALS AND LYMPHATICS.

of the digestion of this portion of the food apparently goes on in the lymphatics.

### The Blood as a Carrier of Nutriment.

In man, and all the higher animals, the distribution of the nutritious ingredients of food to the various parts of the body, as well as the collection of the broken-down materials of the system, is carried on by the aid of a fluid which circulates through all the different portions of the organism. This vital fluid is the blood, which flows out so readily at the least cut through the skin, and is everywhere recognized as constituting the life of the animal.

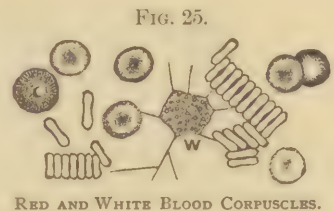
In man, the blood passes through a closed sys-

tem of elastic pipes, called the arteries and veins, or collectively, the blood-vessel system. In these, the blood is kept constantly in motion by the action of a muscular pump. When first forced out of this pump, the heart, it passes into strong-walled branching arteries, the walls of which gradually become thinner as the branches grow smaller, and these end in a network of delicate capillaries, or hair-like tubes, through which the crimson tide flows slowly into the wider, soft-walled veins, appointed to carry it back to the heart, and thus complete the

round of the circulation. In its course, it receives the nutritive materials from the stomach and intestines after digestion, the special products of the liver, spleen, and the lymphatic glands, and the oxygen absorbed from the air in the lungs. It therefore contains and carries to their destination all the materials required for the chemical and vital changes of the various tissues necessary to life. Whilst it passes through the capillary networks of the different organs and structures, it takes up the waste materials resulting from the wearing out and decay of these portions, and carries them to the proper point of escape from the body, as, for example, the kidneys or the bowels; at the same time the nutriment needed to rebuild the worn-out organs, is allowed to ooze through the delicate vessel-walls of the capillaries, and be diffused into the surrounding tissues.

Human blood, when exposed to the air, from which it rapidly absorbs oxygen, is of a bright scarlet color; but when deprived of oxygen, it is dark purplish red. This difference is the great characteristic distinguishing arterial from venous blood, and should always be borne in mind when attempting to staunch the bleeding from a wound, since entirely different treatment is needed in the two cases, as will

be pointed out in the chapter on Wounds and Accidents. The blood is not a red fluid, as it appears to be when first shed; it is composed of a watery portion, called the plasma, which has a light yellow color, and an immense number of minute corpuscles, which give to the blood its crimson hue. These little bodies, which are called the red blood corpuscles, are exhibited in different positions in the accompanying cut, as they appear when highly magnified; the illustration also shows two white or colorless corpuscles, one on the extreme left in a rounded condition, and the other at w, misshapen and entangled in some fibrin threads. The human red corpuscles differ in shape from those of birds and fish, and in size from those of most of the domestic animals, so that a skilful microscopist may often assist in revealing crime, by determining, within certain limits, the character of blood-spots with which a murderer is stained, as has been done by the author of this work in several remarkable instances. The red corpuscles of human blood are shaped like water-crackers, but are so small that thirty-two thousand of them, arranged side by side like a row of pennies, would only cover a line one inch in length. They are therefore entirely too minute to be seen by ordinary eyesight, but under high powers of the microscope these tiny yet eloquent witnesses, as they sometimes prove, to the guilt of "shedding man's blood," are easily recognized. The particular office of the red blood corpuscles appears to be the carrying of oxygen from the air in the lungs to all parts of the system, as explained in the





chapter on Respiration. The red blood corpuscles are remarkable for containing the metal iron, to a larger amount than any other animal structure, except the hair. About forty-two grains of iron, or enough to make a small penknife-blade, exist in the blood of an average-sized man. Minute as this quantity seems, when compared with the entire weight of the body, its presence in that amount appears to be absolutely necessary for the continuance of life. Hence, when a portion of it is lost by an attack of bleeding, the deficiency must be made up from food or medicine, before the destitute individual can hope for the re-establishment of perfect health. This instance is a most impressive illustration of the fact already mentioned, that the smaller yet indispensable ingredients of the human organism, which are supplied in food, must be provided with the most scrupulous care if perfect health is to be maintained.

### The Pulse and the Circulation of the Blood.

Most people have occasionally noticed the throbbing of the heart, on the left side of the body near the lower edge of the ribs, and also felt the

FIG. 26.



CIRCULATION IN THE WEB OF A FROG'S FOOT.

beating of the pulse at the wrist, both of these motions being caused by the movements which propel the blood in its round of the circulation. An exact understanding of this wonderful process of circulating the blood, "liquid flesh," as it has been called, is absolutely necessary to a proper comprehension of health and disease. As already intimated, each new atom of our internal and external organs is brought to its place by the blood, in a state of complete solution. Strange as it may seem, all the bones, no matter how hard they are; all the hair, no matter how black it may be; all the brain, no matter how highly organized it may have

proved itself by its intellectual triumphs, were once, in every human being, part of that almost colorless and transparent liquid, the plasma of the blood; hence every organ stands in relation to the blood in the position of a secretion from that fluid. It is obvious that, in order for the blood to reach every portion of the system, and rebuild every tiny spot of bone or muscle just when and where it is worn out, an immense number of exceedingly delicate channels in every part of the body must be provided.

This wonderful arrangement can be most conveniently demonstrated in the thin membrane of a frog's foot, stretched out under a microscope



magnifying 200 times. In such a preparation, as shown in the marginal illustration (Fig. 26), may be seen the curious capillary network, through which course the blood corpuscles on their way back to the heart by the veins, one of which is shown at *a, a*, receiving a small tributary vein marked *b*; the dark spots represent pigment cells in the skin of the reptile. This flow of the blood in its blood-vessels, the actual current of life, is one of the most interesting spectacles, and should be seen by every one. It might well be ranked among the seven wonders of the world, and persons have often watched it for hours without becoming weary, contemplating with untiring eyes that ceaseless flow, upon which the very life of man, and of all the higher animals, absolutely depends, and at the cessation of which comes death beyond all remedy.

In the human being, it is difficult to demonstrate the circulation of the blood in the capillaries, but the fineness of their network, and the pressure of the blood which is kept up in them to force along the vital fluid, may be readily shown by pricking the finger with a needle, the point of which, no matter how small it is, can scarcely fail to penetrate some minute blood-vessel, and let out a tiny drop of crimson blood.

Of the two sets of blood-vessels, the arteries, which convey the blood from the heart to the tips of the fingers and the ends of the toes, carry bright scarlet blood, and are generally deeply seated in the interior of the body and limbs, so as to be, as far as possible, out of harm's way. The veins, which lie more generally near the surface of the body, as, for example, just beneath the skin on the back of the hand and arm, are filled with dark purple blood, which is much less pure than the arterial fluid, because it contains large amounts of the broken-down materials, the ruins, as it were, of the various bodily organs, which are now on their road to be thrown away out of the system through the lungs, the kidneys, and the bowels. The general structure of the arterial system may be compared to the water-pipes of a large city, of which the chief main corresponds with the great aorta, or large artery, which comes off from the heart; the wider branches of the water-main resemble the large arteries to the trunk and limbs; and the smaller house-pipes, which in their turn divide into the narrow tubes conveying the water into every room of a dwelling, find their analogy in the smaller arteries terminating in the capillary network already described. The venous system is exactly the reverse of the arterial, the vessels, instead of dividing and subdividing in the direction of the blood-current, uniting and reuniting to form larger pipes, which finally convey all the blood by two main channels back to the heart.

The best way to gain a clear idea of the manner in which the blood is propelled by the heart's action, is first to consider the lobster, in which the heart is a simple oval bag, without any partitions or valves, opening at one end of the sack into the main artery, and at the other into the chief

vein. The lobster's heart and large blood-vessels closely resemble a rubber syringe, of the kind called Davidson's, with its gum-elastic ball, inlet- and outlet-pipe. By filling such a syringe with water colored red, and joining the extreme ends of the two pipes with a bit of glass or other tube, you can, if the bulb of the instrument is squeezed at short intervals, pump the fluid round and round through it, so as to exactly imitate the circulation of blood in a living creature of the lobster kind. The circulation of the blood in man goes on in the same way, except that the heart is more complex, having small chambers at the upper part to receive the blood, and larger, thicker chambers at the lower end, called ventricles, to pump it out. Beside being more complex, the human heart is also double, having a right side made up of a moderately strong auricle and ventricle, to send the blood to the lungs, and a powerful left side or left heart, with a thicker auricle and a very thick, strong ventricle, to drive blood to all other parts of the body.

This arrangement of the two independent sides of the heart will be better understood by the aid of the diagram in the margin, which repre-

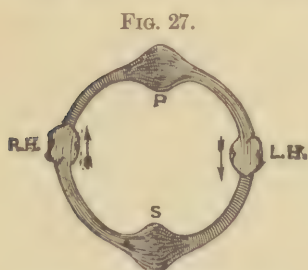


DIAGRAM OF THE CIRCULATION.

sents the two sides of the heart as separated, as they are in reality in the human breast, although there fastened together and *apparently* forming but a single organ. The two sides, however, have no more direct communication than is represented in the cut. In the figure, R.H. indicates the right heart or right side of the heart; L.H., the left heart; P., the pulmonic capillaries, or network of fine blood-vessels in the lungs, through which the blood

must pass to get into the veins on its way back to the left heart; and S., the capillaries of the general system, which have been already described. The arrows indicate the direction of the blood-current in the entire round of its circulation.

### The Human Heart and Its Functions in Health.

The human heart is a pear-shaped muscle, about the size of the fist, hollow, like a bag, but with very thick walls. It is divided inside by fleshy and membranous partitions into four parts, very much as a four-roomed house is divided into rooms by its ceiling and partitions, with communicating doors through each of the latter. These doors correspond to the valves of the heart, which are shown in the figure illustrating the Diseases of the Heart, further on in this volume, although the best way to comprehend their structure and curiously ingenious mode of action is to examine the real heart of a sheep, ox, or pig, in the fresh state from a butcher's shop. The valves consist of a skin or membrane hung across each side of the opening between the chambers of the heart, like curtains,

in such a manner that the blood, in running one way, presses them flat against the sides of the hole, and then, as the heart's contraction attempts to drive the vital fluid back again, some of the blood is forced in behind the curtains, and swelling them out so that they meet in the middle, makes them entirely shut off the return-current of the blood. This principle of curtains, or flaps, or pockets in the sides of tubes, is the general one upon which valves are constructed in the animal body. Such valves are to be found not only in the heart and the veins, but also in the lymphatics and in the alimentary canal. They are admirably ingenious and effectual whilst they remain perfect, but when they get out of order and leak a little, they produce some of the most distressing diseases which mankind is ever called upon to suffer from, although, strange as it may appear, these maladies are caused in a purely mechanical way.

The beats of the heart, which in health exactly correspond to the pulsations at the wrist, in the radial artery, as it is called, number about seventy a minute in an adult man. In a woman the average is about seventy-five per minute, and in children the heart-beats are more frequent in proportion to their youth. In an infant, soon after birth, the pulsations are from one hundred and ten to one hundred and thirty per minute. Since the heart, every time it beats, pumps into the great aorta about six ounces, or rather more than one-third of a pint of blood, and there are about eighteen pounds of the vital fluid in the body of an average-sized man, the whole quantity of blood is believed to pass through the entire round of the circulation every half minute of our lives. With each pulsation of the heart may be heard two sounds, caused, at least in part, by the sudden shutting of the valves. These sounds, in a healthy person, may be compared to those of the words "lupp-dup," and since they are changed in certain diseases of the heart, physicians find in them their best guides as to the state of the valves in such cases. Any one who has quick ears can hear these sounds of the heart beating, as Longfellow has said, "funeral marches to the grave," by listening at another person's chest, on the left side, near its middle, and over the fourth rib; but it requires a great deal of practice to decide by them whether the valves concerned in producing the noises are healthy or diseased.

The circulation of the blood through all parts of the body, except the lungs, is called the greater circulation, and that which goes on in the lungs has received the name of the lesser or pulmonary circulation. About three hundred years ago, the true course of the blood-current through both sides of the heart, the arteries, and the veins, so as to form one circle, was first demonstrated by the celebrated Dr. Harvey. Before the time of his great discovery, only the lesser or pulmonary circuit was known. The value of examination of the pulse, as an index to the condition of the system, the onset and progress of disease, and the immediate danger



of death, is so great, that special attention is invited to the subjoined diagram and accompanying detailed explanation.

The left side of the heart, marked L.H. in the figure, pumps the blood into the systemic arteries, and thus keeps these vessels over-filled; the larger systemic arteries, A., by their elasticity, exert continuous pressure on the blood with which they are distended; the smallest systemic arteries, A', by their vital contractility, check and regulate the amount of blood flowing out of the larger arteries into the capillary network, and thus keep up the constant pressure or tension in the larger arteries; the systemic capillaries, marked S.C., are the portions of the vascular system where the great operations of the blood are carried on, that where the worn-out particles from all the tissues of the body are removed and the

new atoms for rebuilding these same tissues are supplied; the wide systemic veins, V., are the passive channels conveying the impure blood back to the right side of the heart; the right or pulmonary side of the heart, R.H., pumps the blood into the arteries of the lungs and distends them, though less fully than is the case with the systemic arteries; by the pulmonary arteries, P.A., the blood is carried through the pulmonary arterioles or smallest arteries, Pa, to the pulmonary capillaries, P.C., where it is exposed to the inbreathed air and exchanges its poisonous carbonic acid for the active life-giving oxygen; the letters Lh indicate the lymphatics, ending in the thoracic duct, as already described, and receiving in their course the lacteals, Lc, which absorb the nutriment of the food from the stomach and intestines, designated by I. in the diagram.

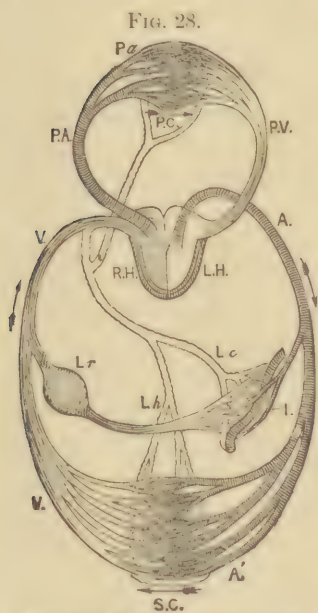


DIAGRAM OF BOTH CIRCULATIONS.

Although the blood enters the arteries from the heart by jerks, and this jerky movement is kept up in the medium-sized and smaller arteries constituting the pulse as it may be felt in the wrist, ankles, temples, or below the angles of the jaw, the motion in the capillaries is a constant one. This is because the arteries are kept over-full by the action of the heart. The arterioles or smallest arteries are the chief agents in resisting the outflowing of the blood at too rapid a rate into the capillary network, and so keeping up the arterial pressure. As death approaches, and the power of the arterioles to contract becomes feeble, in most cases the arterial pressure grows less, and the weakening pulse indicates the oncoming of dissolution. So sure a sign may the characters of the pulse prove of a fatal result, that we read that a celebrated physician, tossing in delirium on his death-bed, happened to let the skilled fingers of his right hand fall

upon the other wrist. For a few moments he felt the failing beats of his death-stricken pulse, and then, bursting into a mocking laugh, he exclaimed, "Ha! you have called me too late, this man will die." And, sure enough, before another twenty-four hours had passed, the throbbing heart, which nourished and sustained that wise and far-seeing brain, unerringly foretelling, even when half unhinged, its own fate, had ceased forever its pulsations in the stillness of death.

Returning now from the digression rendered needful by the necessity for securing a full comprehension of the method by which the nutritious ingredients of food are distributed to all portions of the animal economy, we come to a brief consideration of the culinary preparation of the various articles of diet.

Where economy of nutriment is an important object to be attained, it is probable that the production of broths and soups, from vegetables and meat in combination, affords many and great advantages. In making nutritious broths with a fair allowance of butcher's meat, it is advisable, when possible, to cook the vegetables separately, and the meat, if intended to be eaten with the soup, should be cut up into small pieces. In any case, the meat should be put into cold water, but should not be boiled, except when the vegetables are cooked in the same utensil, a temperature of about 150° Fahrenheit being quite sufficient. If the meat is plunged into hot or boiling water at the outset, the external layer of albumen is coagulated, and the juices are prevented from exuding.

In boiling meat, on the other hand, when the object is to retain as much as possible of the soluble juices in the meat, the piece ought to be of good size, and it should at once be plunged into boiling water, to coagulate the outside albumen. After being kept boiling for about five minutes, the saucepan should be placed aside, and the temperature allowed to lower gradually; or it may be lowered by the addition of three pints of cold water to each gallon of boiling water.

In boiling fish, the addition of salt makes the flesh firmer and more retentive of the flavor. In cooking green vegetables, they should first be carefully washed in cold water, but not allowed to remain in it, then plunged into boiling water and cooked rapidly. Potatoes should be boiled in their skins, and after boiling for about five minutes, most of the water should be poured off, and then the potatoes should be steamed.

In roasting meat, the joint should be placed at first before a brisk, hot fire, with a view, as in boiling, to coagulate the outside albumen, and then the roasting may be conducted more slowly. In roasting, there is greater loss in weight than in boiling; and although the latter process may be considered slightly more economical, the flavors which give such a pleasant relish to the meat are not so freely developed. In baking meat, the loss is also greater than in boiling, and if the temperature is high and the oven close, the meat too often becomes ill-flavored and indi-

gestible; indeed, roasting is always to be preferred to baking, unless the meat is covered, as in a pie, and then the baking should take place slowly. Baked vegetables and fruits demand the same slow treatment.

Stewing has this advantage over dry-baking—that there is no risk of charring, and the meat is rendered juicy and tender. Tough and strong-flavored meats are, perhaps, best cooked in this way, because they can be rendered very palatable and digestible by the addition of vegetables and seasoning. Frying is even worse than baking, unless very carefully done; but broiling on the gridiron is an excellent way of cooking chops, steaks, kidneys, and small dishes of fish or fowl.

The English plan of braising is a mode of cooking meat which is, perhaps, too much neglected. By this process the meat is just covered, and no more, with a strong liquor made from vegetable and animal juices or stock. The covered utensil, with a close-fitting lid, is then exposed, with its contents, to a surrounding heat short of the boiling-point, and the cooking is allowed to proceed slowly. By this process, tough meats are rendered juicy, tender, and very agreeable to the palate.

In boiling, baking, and roasting, the average losses of weight of different kinds of butcher's meat are about 23, 31, and 34 per cent. respectively. In the cooking of salt meat, the heat should be very slowly applied and long continued.

### **Eat to Live, not Live to Eat.**

In regard to the periods for eating, experience proves that habit is one of the most important agents in determining the times we ought to partake of nourishment. When a systematic regularity in respect to the period when we introduce food into the stomach is observed, the digestive processes are all better accomplished, and the food is more thoroughly and completely assimilated, than when meals are eaten irregularly. That curious memory of the body is nowhere more unfailingly expressed than in the demand for food, so loudly made by the stomach, especially of a laboring man, when the dinner-hour arrives, and every one is familiar with the fact that, if unavoidably prevented from satisfying the hunger at the usual time, all appetite may sometimes be lost, and food, if forced into the stomach, remains often for hours a useless and injurious load upon the digestive apparatus, even if it is not cast off by vomiting. The usual number of meals eaten daily by most inhabitants of the United States is three, the first, as is wisest, soon after rising in the morning, nourishing enough to repair the exhaustion consequent upon the long fast of the night, and yet not so heavy as to overload the stomach during the morning, when the most active exertion of the day is usually performed. Much diversity of habit obtains in respect to the next meal, which should, however, if possible, be eaten between twelve and two o'clock, and be composed of the most abundant quantity and most nutri-



tious quality of food, put into the stomach in the twenty-four hours. If this meal is made the principal one, as it ought to be, severe bodily exertion or hard work of any kind should be avoided for at least half or three-quarters of an hour subsequently. Although many people find it impossible to adhere to this rule, it is not any less important hygienically on that account. The evening meal should be partaken of at least two hours, and preferably four hours, before retiring. It should be made up of foods derived chiefly from the vegetable kingdom of nature, those which have been proved by individual experience to be light and easily digestible, and both the bulk and quantity of nutriment taken into the stomach ought to be less than at either of the other repasts. The practice of eating late dinners and depending upon light luncheons to sustain the strength during the hardest part of the day's work, is a grievous sin against the laws of hygiene, and is fraught with many evil consequences to the digestive apparatus, among which dyspepsia, that inexorable minister of hygienic justice, already referred to as the remorse of a guilty stomach, is perhaps the worst.

It has been suggested, in a very general way, and one admitting of numerous important exceptions, that most people would find it advantageous to eat for breakfast wheat-bread, twelve or more hours old, bran-bread or oat-meal porridge, plenty of good butter, a little stewed mutton or chicken, or a soft-boiled egg, provided there is no idiosyncrasy forbidding it, with milk, chocolate, or water as a drink. For dinner eaten soon after mid-day, roast or boiled beef, mutton, lamb, or fowl, with white or sweet potatoes, beans, or peas, in small quantity and first-rate quality only, and for dessert, sound ripe or dried fruits in season. For supper, which ought to be a very light meal, bread and butter with a little stewed fruit, and milk or cold water only, will be apt to promote sound and refreshing slumber. Making due allowance for differences in external temperature, amount of labor, habits of life, and so forth, the world would probably be filled with far healthier and happier inhabitants than it now is, if bills of fare similar to this, and this alone, were allowed. It is true that the cunning contrivances with which cooks tempt poor frail humanity are not all positively poisonous, yet they are nearly all more or less injurious, and the large majority of mankind would enjoy much better health if no such things as pies, cakes, candies, fried oysters, lobster-salad, cheese, cream-puffs, roast pork, sausage, veal cutlets, corn-beef, boiled cabbage, and all the different varieties of fried dishes, had never been devised. Notwithstanding the enormous extent to which they are consumed, tea and coffee have little real value as foods, and should rarely be employed, by young and growing persons, at any rate. Variety in diet from day to day is highly favorable to health as well as grateful to the palate, and systematic changes should be made according to the season of the year, more fatty and nitrogenous food being used in cold weather

and cold climates, whilst starchy and saccharine articles of diet are employed in larger proportion when exposed to the influences of a torrid season or zone.

Some readers may perhaps be tempted by the demon of gluttony to object that, in the scheme of diet above set forth, no provision is made for the plum-pudding and nut-brown ale of merry Christmas and other holidays. Although such dishes and beverages have really no place in a thoroughly hygienic dietary, it is possible to apply the principles already enunciated in regard to the digestive process in such a way as to markedly diminish the dangers of unsuitable food.

### **How to Eat a Christmas Dinner with Safety.**

In the first place, as already hinted, the thorough mastication of articles of diet, especially by the third set of teeth, is more important to health than is usually believed, because, during this process of chewing, nature intends not only that the alimentary substances shall be broken up into a coarse powder, but also that this powder shall be completely mixed with the saliva, which has a powerful influence in preparing the starchy ingredients for solution. Hence persons should eat very slowly, chew thoroughly, and move the mouthful of food freely about from one cheek to another, in order to amply impregnate it with the fluids of the mouth, and this precaution is particularly valuable when the food happens to be less digestible in quantity or quality than is customary. That part of digestion which largely goes on in the mouth and throat, namely, the conversion of insoluble starch which exists in bread, potatoes, and so forth, into soluble glucose or grape-sugar, is of course chiefly exercised in regard to vegetable nourishment, and mankind may learn a useful lesson from the inferior animals in this respect, as in many others, by observing that, whilst a dog or other carnivorous beast will rapidly bolt his meat, herbivorous animals, such as the cow, spend many hours of the day in slowly masticating over and over again their large bulk of vegetable provender.

A second very important aid in enabling men to fulfil the wish, which most people occasionally entertain, that they may for once overload the stomach without having to suffer for it, is the proper regulation of exercise after eating. A very deliberate walk for half an hour or so in the open air, when the weather is not too cold, accompanied by the stimulus of cheerful, but not exciting nor absorbing, conversation, is decidedly conducive to the successful digestion of a bulky meal. That violent exertion interferes very much with the digestive process, is shown in a curiously impressive way by the famous experiment of Sir John Hunter, who, it is said, fed two dogs equally, and then took one of them out to run after a hare, whilst the other was allowed to lie down and sleep. At the end of an hour both were killed, when the food in the first dog's stomach was found to be almost unaltered, whilst that in the second dog was nearly digested,



and had almost all passed out through the pyloric orifice or lower gastric opening. The mere bulk of a very hearty meal probably has a decided mechanical effect in interfering with its own digestion, by not leaving room in the stomach for the necessary amount of the solvent fluid or gastric juice to be poured out as is requisite. The quantity of this liquid which is secreted daily into the stomach being, as already mentioned, about a gallon and a half, it is obviously important that the stomach should not at any time be packed so full of food that even a small additional bulk of gastric fluid would over-distend it, and, by causing a backward pressure at the mouths of the peptic glands, whose business it is to manufacture the gastric juice, greatly interfere with their secretive power, and consequently with a full supply of this precious digestive liquid. Hence it is advisable for those who fall victims to the seductive charms of cooks, confectioners, and caterers, to eat smaller and more frequent meals, or to leave comparatively long intervals between courses whilst at table, in order that this purely mechanical impediment to digestion may not supplement and aggravate the dangers from indigestible food.

Sometimes, where the secretion of the digestive fluids is deficient in quantity, or where over-eating has been indulged in, considerable aid to the digestive process may be given by swallowing the substance called pepsin, either in its pure state, dissolved in wine or other fluids, or in its various combinations, of which the mixture which goes by the name of lactopeptine is one of the best. These substances should be taken in doses of from two to ten grains after each meal, if used in the solid form, or the equivalent quantity of any of the solutions may be administered, often with great advantage.

The diseases connected with excess and deficiency of food otherwise wholesome, form a large class, and merit a much fuller discussion than space permits in this chapter.

### **Injuries to the Health from Excess of Food.**

When the stomach is overloaded with food beyond its power of digestion, nature often relieves the abused organ by the process of vomiting, which no doubt frequently saves people who violate the laws of hygiene in this respect from the penalty of death, or at least of prolonged illness. When, however, the digestive organs are not unloaded in this manner, the ordinary chemical changes, which occur in warm, moist animal and vegetable matter outside of the body, set in, and fermentation or putrefaction occur, large quantities of gas being sometimes produced. The gases in such cases consist chiefly of carbonic acid and sulphuretted hydrogen; and, by the mere mechanical distension to which they subject the bowels, may give rise to colic and other distressing complaints. When, however, it happens that the flatulent condition is mitigated by the escape of the offending gases, the solid matters often remain and accumulate to



an almost incredible extent, so great an amount as thirty pounds of half-putrid material having been brought away from a case of this kind by the action of vigorous purgative medicines. Where a smaller mass of decomposing substances has been retained in the bowel for a considerable length of time, symptoms of mild blood-poisoning, such as foulness of the breath, fever, drowsiness, and so forth, produced apparently by the absorption of putrid matters into the blood, have been observed. Although diarrhœa is very apt to come on in such instances of over-accumulation of undigested food in the alimentary canal, it does not always, strange to say, empty the intestines of their offensive load, and it is only by the aid of active purgatives that the removal of the cause of the difficulty can be effected. Even where the excessive amount of food which is taken into the stomach is not sufficient to produce this kind of mechanical obstruction, it may still have a very injurious influence by overtaxing the assimilative powers of the various organs of the system. Thus, when a superabundance of proteid substances is eaten, and perhaps imperfectly digested, whilst at the same time, as often happens, a diminished quantity of exercise or labor is performed, there must almost necessarily be a disproportion between the oxygen inhaled by the lungs and the nitrogen absorbed from the food, when they meet in the blood, and therefore a disturbance of the assimilative processes. Although not completely proved, it is highly probable that gouty and perhaps rheumatic affections arise partly in this way, although the direct influence of certain alcoholic drinks in producing gout is indisputable. Sometimes we meet persons who, though they eat a great deal of meat, escape the gout, not even presenting the appearance of being over-fed; but Dr. Parkes explains this seeming contradiction by supposing that, in such instances, either a great amount of exercise is taken, so that the excess of nitrogenous material is rapidly burned off, or else that the meat is only partially absorbed, owing to imperfect mastication. Some physicians, by experimenting upon themselves, have shown that eating a great excess of meat without other food may produce, in the short period of five days, fever, diarrhœa, and general discomfort. If persevered in, symptoms resembling those of the early stage of Bright's disease made their appearance. Superabundance of starchy articles of diet appears to be less directly hurtful to the system, because a larger proportion of the excess passes off from the bowels in an unchanged condition. Troublesome corpulence may sometimes result, however, from eating too much starchy food, and it has been supposed that attacks of diabetes, a disease which is characterized by the presence of sugar in the urine, are occasionally due to the same error in diet.

### Deficiency of Food as a Cause of Disease.

In former times, the disastrous effects of famine were only too often seen; but in our own day and country, the event of any human being actually starving to death is fortunately rare. We are, however, occasionally compelled to witness the agonies of this mode of dissolution in cases of cancer of the throat, where food cannot be swallowed, or of cancer of the stomach, where no nourishment can be retained. Perhaps nowhere, in America at least, have the evils of insufficient diet been more terribly exemplified on a large scale than in the prison-pen of Andersonville, Georgia, during our late civil war. According to the sworn testimony of some of those who escaped its horrors, "the rations consisted of eight ounces of corn bread, the cob being ground with the kernel, and generally sour, with two ounces of condemned pork, offensive in appearance and smell, for each man daily. Occasionally, that is to say about twice a week, two tablespoonfuls of rice were allowed, and in place of the pork about two tablespoonfuls of molasses were given to us about twice a month. This ration was brought into the camp about 4 o'clock p. m., and thrown from the wagons to the ground, the men being arranged in divisions of two hundred and seventy, subdivided into squads of ninety and thirty. It was the custom of the prisoners to consume the whole ration at once, rather than attempt to save any of it for the next day. The distribution being often unequal, some would lose their rations altogether. We were allowed no dish nor cooking utensil of any kind. To the best of our knowledge, information, and belief, our ration was a starving one, it being either too foul to be touched or too raw to be digested."

After what has been said on page 150 respecting the amount of food necessary to man, the reader will probably not be surprised at the awful death-rate which prevailed among these unfortunates. The number of prisoners was at this period about thirty-five thousand, and the deaths were one hundred and thirty per day, or at the rate of over forty-seven thousand per year. In other words, the last of these poor creatures would have died in about nine months, had the same number continued to perish daily for that length of time.

The narrators continue: "The proportion of deaths from starvation, not including those consequent on the specific diseases originating in the character and limited supply of food, such as diarrhœa, dysentery, and scurvy, they could not state, but to the best of their belief there were many score every month. We could at any time point out many for whom such a fate was inevitable, as they lay or feebly walked about, mere skeletons, whose emaciation exceeded the examples figured in the illustrated papers of the day. For instance, in some cases the inner edges of the two bones of the arms, between the elbow and the wrist, with the intermediate blood-vessels, were plainly visible when held toward the light." As to the

condition of system resulting from this starvation diet, Dr. Chapel, who received one hundred and five of these paroled prisoners at one of the Baltimore army hospitals, gives the following medical testimony: "These were the worst cases arriving then, none of them being able to stand alone. Nearly all were in an extreme state of emaciation, filthy in the last degree, and covered with vermin. Several were in a state of semi-insanity, and all seemed, acted, and talked like children in their desire for food, and so forth. Several had no disease whatever, but suffered only from extreme emaciation and starvation. The limb of one of these men could be spanned with the thumb and finger just above the knee. This patient, a boy of nineteen, would not weigh over fifty pounds then, although in health his weight was probably one hundred and thirty-five pounds. His was not a solitary instance, many poor fellows presenting the appearance of mere living skeletons, with the skin drawn down tightly over their bones. Many more, however, were laboring under such diseases as dropsy, pulmonary consumption, scurvy, and mortification from cold, several having lost the half of both feet from this latter cause."

The terrible mortality which prevailed amongst the British troops in the Crimean war was to a very large extent attributable to the insufficiency of the food-supply. No extra allowance of food was granted to the soldiers on account of increased exertion and exposure to cold, and the result was that within a few months the death-rate from diarrhœa, dysentery, scurvy, and fever, rose to thirty-nine per cent., and in some regiments to seventy-three per cent., of the total mortality. As regards the civil population, the history of relapsing fever is almost exclusively a narrative of disease arising from destitution, as was illustrated in the famines of 1817 and 1847 in Great Britain. Moreover, the connection of scurvy with an insufficient or badly arranged diet, especially among sailors, is notorious.

#### **Gradual Failure of Health from Slow Starvation.**

The symptoms of failing health, as a result of insufficient diet, are a gradual loss of flesh, advancing to extreme emaciation. The pulse becomes feeble, and the complexion sallow. Even moderate exertion brings on palpitation of the heart, vertigo, and transient blindness, and diarrhœa or dysentery is a common symptom. Of this train of evil consequences, no more remarkable example could be quoted than the account given of the sanitary condition of the Millbank prison many years since. The prisoners confined in this establishment, which is situated on the Thames River, near London, had previously received a daily diet equivalent to between thirty-one and thirty-three ounces of dry nutriment, when it was resolved, during some reform administration doubtless, to economize by reducing this allowance to twenty-one ounces, and to exclude, or almost exclude, animal flesh from the diet-list. Up to this time the prison had been considered fairly healthy, but within a few months after



the new diet-scale had been introduced, the health of the inmates began to give way; the first symptoms being loss of color, gradual loss of flesh, and general debility. At last, numbers of the men were attacked with diarrhœa, dysentery, and scurvy, and cases of convulsions, maniacal delirium, and apoplexy grew common. About fifty-two per cent. of the prisoners were more or less affected in this way, and to prove that the reduction of the diet was the chief, if not the sole, cause of the epidemic, it is narrated that the prisoners employed in the kitchen, who were allowed an additional eight ounces of bread daily, and had some additional opportunity for stealing scraps of food from the other rations, continued in good health, whilst the alarming sick-rate continued amongst the others, until true economy again prevailed over its counterfeit, and the diet-scale was restored to its original standard.

The minor effects of insufficient food are, as a general rule, so intimately associated with those of other causes, that it is impossible to estimate, with any approach to accuracy, their separate influence upon the public health. Long before actual want of food is experienced through poverty, the clothing and the fuel will have become scanty, and uncleanness and overcrowding will have begun their evil work.

#### **Health-Failure from Deficiency of One Class of Food-Elements.**

The results of that sort of partial starvation produced by deficiency of one of the four great classes of foods, the others being supplied abundantly, are of great interest and importance from a hygienic point of view. They have not as yet, however, been fully determined in respect to all the groups.

The complete deprivation of the nitrogenous elements, without any lessening of the other classes, produces marked effects only after several days. Dr. Parkes found full vigor preserved for five days in a strong man fed on fats and starchy substances, and in another case, where the amount of nitrogen was reduced one-half, strength was retained for seven days. If this variety of abstinence is prolonged, however, there is eventually great loss of muscular strength, often mental debility, with feverish and dyspeptic symptoms. Then follow the profound impoverishment of the blood, called *anæmia*, and great prostration. If the reduction of the nitrogenous elements is only partial, so that one-third or one-fourth of the proteids is still furnished, the body gradually lessens in its activity, and the diminishing muscular strength and impoverished blood, called by a noted French physician *physiological destitution*, which predisposes to the specific diseases, such as malarial, typhoid, and typhus fevers, pneumonia or lung fever, and so forth, comes on. It also renders attacks of these maladies much more surely and speedily fatal.

The deprivation of starchy constituents can be borne for a long time if plenty of fat be given; but if both fat and starch be excluded from the

diet, nitrogenous food being supplied freely, illness is produced in a few days. This is easy to explain when we remember that, as pointed out when speaking of the gang of one hundred prisoners, in order to get enough carbon, at least three times as much nitrogen as can well be assimilated is introduced into the stomach, unless, indeed, an enormous amount of physical exertion or labor is performed, in which case, again, the amount of carbon is insufficient. It is true that men can be fed upon ordinary flesh for a long time, as in this way a good deal of fat is introduced: and if the meat be fresh and raw, there is much less danger of scurvy being developed. Certain classes of people in South America are reported to live almost entirely upon animal flesh, but they spend most of their time in the open air and are engaged in active exercise. The deprivation of fatty food is not apparently well borne by the human system, even although the starches be furnished in sufficient quantity. The wonderful effects of fat or oil, such as cod-liver oil in some diseases which are obscurely connected with failure of the nutrition of the body, indicate that the evil results of partial deprivation of fat are both more common and more serious than is generally supposed. In nearly all the diet-lists established for soldiers, sailors, and prisoners, the fatty constituents of food are largely deficient. The deprivation of saline materials is also attended with marked injurious consequences, which, as already hinted, are worthy of far more extended study than they have yet received. The inexorable necessity imposed by nature upon the animal economy, to procure a sufficient supply of common salt, is impressively shown by the toilsome journeys of hundreds of miles which animals, such as deer, will make, and the dangers they will brave, to secure the small amount of salt obtained in the salt licks of our Western States; or, again, the avidity with which chickens will seize and fight for a fragment of egg-shell, demonstrates the power of the instinct which teaches them that lime, such an essential element in the bony skeleton, is an absolutely necessary ingredient of their food, and must be eagerly swallowed whenever they can procure it.

### **Injuries to Health from Adulteration of Food.**

Much has been written in regard to the mixture of inferior, useless, or poisonous substances with the various articles of diet, and almost all nations have, in nearly all ages of the world, found cause to prosecute the fraudulent adulterations of food-stuffs. The mere presence of laws upon the statute-books of England, and some of the more fortunate States of America, has a powerful deterrent effect upon those who would otherwise be apt to seek pecuniary gain by this kind of trickery; and even more powerful than the fear of law is the dread of public opinion, which happily considers, and that most justly, that fraud in articles of food is one of the worst, if not the worst, form of roguery—one which it is the duty of



every good citizen to aid in punishing without mercy. Nor in these days of energetic reporting for the public newspapers, is there much chance for this kind of a guilty man, if detected, to escape.

The great difficulty in preventing adulteration of food in our own country lies, therefore, in the detection of the fraud, and for this purpose a far more thorough and systematic inspection of all articles of diet should be legally established, since upon the purity of the food-supply depend not only the health and comfort, but often the *very life* of a nation. As an illustration of the national importance of this question, it may be mentioned that good authorities assert that several mills in New England, and probably many elsewhere, were, a few years ago at least, engaged in grinding white stone into a fine powder for purposes of adulteration. At some of these mills they ground three grades, known respectively by the names of soda-grade, sugar-grade, and flour-grade. As thus prepared, these powders are said to sell for half a cent a pound, and it does not require a tithe of Solomon's wisdom to know that the activity of this branch of the milling business indicates a vast amount of adulteration in many of the food-stuffs and medicines sold all over the country. As a general rule, the mixtures of this kind are like that of white stone-powder, and the *terra alba* or white earth, harmless in themselves, and only injurious from a strictly sanitary point of view, in that they diminish the nutritive value of the articles of diet, and so tend to impoverishment of the system. Not the less, however, are these adulterations criminally dishonest. One of the most stupendous substitutions ever accomplished is now running its career in this country in the manufacture of as much as half a million of tons of corn-starch sugar or glucose, all of which steals its way through the avenues of trade to the mouths of consumers, under the guise of ordinary cane-sugar. The solid sugar called grape-sugar at the factories, is mostly mixed with some granulated cane-sugar, and thus vended as genuine. The syrups which go by the name of glucose require little or no mixture with cane-syrups to fit them for market. Whilst real cane-sugars have long been carried through the course of trade at slight and insufficient profit, the consumer of this so-called grape-sugar probably pays on it from three hundred to eight hundred per cent. above its actual cost. It is authoritatively stated that the glucose factories could sell it with profit at one and a half cents per pound, and actually do sell it at from three to four cents per pound. At retail it brings as good prices as genuine sugar, but probably is not sold to private customers at all under its own right name.

Among the more common adulterations, proved by analysis to have been made with substances injurious or dangerous to health, may be mentioned the following. Cayenne pepper has frequently been found mixed with large amounts of starch, colored with red-lead, which is well-known as a violent poison; much of the "pure cider vinegar" is mingled



with a very dilute solution of sulphuric acid, colored to the proper hue with burnt sugar; pickles of various kinds sometimes are exposed for sale containing small amounts of copper, to which their brilliant green tint is due; many varieties of the cheaper kinds of candies and other confectionery, are tinged with compounds of lead, copper, and arsenic, the latter particularly in the form of the aniline dyes; baking-powders often contain alum, which, without being positively poisonous, is to some people a highly injurious ingredient of food. It is probable that very little of the wine and brandy which is sold in the United States, is free from adulteration, and in many instances the substances employed to aid or to conceal the sophistication of the liquor are active poisons. The adulteration of milk, which is almost always performed by adding water, is generally only a fraud, but sometimes attains the magnitude of a crime, either by causing the deaths of infants who depend on it for nutriment, which in its dilute condition it does not supply, or by being the vehicle for contaminated water drawn from some polluted barn-yard well, and loaded, perhaps, with the poisons of typhoid fever, scarlet fever, or diphtheria.

The beneficial effect of laws to punish the adulteration of food and drink is well seen in Canada and in Great Britain, to which countries unquestionably is due the honor of leading the world in legal and scientific measures to enable people to obtain *pure and honest food*. A few years since, in England, about eight thousand samples of food and drugs were examined annually, and of these some fifteen hundred were discovered to be adulterated, and the offences dealt with by moderate penalties. Under the mild and equable operation of this enactment, there has been, year by year, a decrease in the number of adulterations found in proportion to the analyses made by the authorities. Thus, in 1872, the proportion of adulterations discovered was sixty-five per cent., whilst in 1878 the ratio of sophistications detected was only a little over sixteen per cent. In Canada, under a similar law, the ratio of adulterations found was fifty per cent. in 1877, and only thirty-three per cent. in 1878, more than eight hundred analyses being made in the year last named.

#### Hygienic Considerations in Regard to Meat.

Coming now to a consideration of particular articles of diet in their sanitary relations, both in a pure and an impure state, in which latter condition they are often, as is well known by everyone, most potent causes of disease, the first and most important on the list is butcher's meat. The characteristics of good meat may be enumerated as follows: In the first place, when cut, it should present a marbled appearance, from the intermixture of streaks of fat with the muscle, this aspect showing that the animal has been well fed; secondly, the color of the muscle should neither be too pale nor too dark; if pale and moist, it shows that the animal was too young for good food, or else that it was diseased; if dark or livid, it indi-

cates that in all probability the animal was not slaughtered, but died with the blood in it; thirdly, the fat should be firm to the touch, not moist nor sodden, and free from minute spots of blood; fourthly, any juice exuding from the meat ought to be small in quantity, have a reddish tint, and give a decidedly acid reaction with the blue litmus test-paper. The juice of bad meat, that is to say, meat which has begun to putrefy, is neutral or alkaline; fifthly, the bundles of muscular fibres in the meat should not be large and coarse, and there should be no sticky and yellowish matter fluid to be discovered between them. Good meat ought to dry on the surface, without changing from its red color, after standing for a day or two exposed to the air. Sixthly, the odor should be slight, and by no means disagreeable; any unpleasant smell about the flesh indicates either that it is commencing to putrefy, or that the meat is from some diseased animal. By chopping a portion of the flesh into small pieces, and pouring over it some warm water, any disagreeable odor existing in it will be more readily detected. Another good plan is to thrust a long, clean knife into the meat, and then carefully examine its odor after withdrawal.

#### **The Unwholesomeness of Unsound Meat.**

Testimony is very conflicting in regard to the precise amount of injury produced by unsound meat, that is to say, meat which has become more or less decomposed, when used as food. The prejudice in the community, as well as the opinion of most physicians, is very strongly against its employment. Yet the freedom from disease as a result of eating flesh which has been kept so long as to reach that stage of commencing putrefaction, when it acquires the odor and taste called by the European epicures "the game flavor," as well as the absence among certain savages of any ill-effects from consuming putrid meat, render it doubtful how far it is positively injurious. It should be remembered that meat may not reach the standard of good food and yet be perfectly wholesome, so difficult is it to lay down rules to which there are no exceptions. For example, says Dr. Fox, a perfectly fresh leg of mutton is tough and by no means pleasant eating, but if kept until it begins to lose some of the characteristics enumerated as indicating good meat, which may be a long time if the weather be cold, and especially if the air be dry, it will be rendered tender and digestible. But notwithstanding so many instances of apparent escape from injury after eating unsound meat are recorded, there is very little doubt that if accurate experiments upon a large scale could be performed in relation to this important problem, it would be found that, when taken into the stomach without thorough cooking, meat of this kind produces, in a vast majority of cases, a depression of the general health, if not actual sickness. The disinfecting influence of good culinary preparation in the kitchen, and the great power of the system to select and assimilate what it requires, rejecting what is superfluous or injurious, probably pro-

fect active, vigorous persons from the harmful effects of eating unwholesome meat. But for the weak and the sick, and for all those who live under the complicated physical and mental strain of a highly civilized existence, demanding, as it often does, from their brains and muscles *all* the work which can be got out of them, it seems obviously important to have every condition of living as perfect as it can be made, and to admit no source of even possible evil into the system. Nor should persons be deceived by the seeming tolerance of baleful influences, which their internal organs manifest as a result of long habit. If meat is salted after it commences to grow unsound, a slight amount of putrefaction would thereby be arrested, and in such cases decomposition would often pass undetected. This would not conceal its deterioration, if softening, discoloration, or marked odor were present, before the salt were applied. The sausage, which a witty English writer upon sanitary subjects has recently described as being composed of "skin and mystery," is the grand receptacle of vile meat of every kind, where it is spiced and flavored into obscurity. Even here, however, in the vast majority of cases, thorough cooking may be relied upon to prevent any poisonous results. Still Bologna sausages are eaten raw, and in some of the large cities it is reported that fetid and actually rotten meat is sometimes used in their manufacture. Occasionally veal is dressed for such a purpose, which the owners would not dare to offer for sale in any market, and not unfrequently at these sausage manufactories are received the carcasses of animals in which the killing has been nearly, if not quite, a work of supererogation. In certain stages of the decomposition of ham, sausages, and bacon, there appears to be developed a substance which has a powerfully poisonous action upon the human system. Its chemical composition has not yet been determined, but there can be no doubt of its virulence. It may not have caused such fatal results here in America as have been observed from it in Europe, and yet cases of death from such a cause might readily pass undetected where we have no careful system of medical police. In Wurtemberg alone, it is stated that four hundred people have been made ill, and a hundred and forty have died, from the effect of this sausage-poison during the past half century. The poisonous properties of brine, or other pickling solutions, which have been used over and over again, and which seem to cause occasionally such serious or fatal attacks of illness, may perhaps be due to similar chemical changes in the animal principles which they have dissolved.

Certain damaged meats, such as mouldy veal, musty bacon, decaying mutton or sausages, potted meats, pork pies, and so forth, have certainly, when in a state of incipient putrefaction, acted sometimes like irritant poisons upon the human system, producing great nervous prostration and collapse. As a general rule, the mere sense of smell and of sight will enable any one to discover this condition of an article of food, but in all



doubtful instances a microscopic examination should be resorted to. The detection of decomposition in sausages frequently proves more difficult. It has been recommended to stir up the suspected sausage with water, boil the mixture, and add freshly-prepared lime-water, when an offensive odor will be evolved if the meat is unwholesome. The existence of an acid reaction, an unpleasant odor, and a nauseous taste, are signs of unfitness for human food in any such articles of diet. A recent writer on preventive medicine says, that foods, whether vegetable or animal, in a state of decomposition, ought to be rigorously excluded from all diet-lists. The idea that some foods can be taken into the stomach when they have the so-called high or game flavor, which they possess when actually swarming, as the microscope shows, with low forms of animal and vegetable life, is a fallacy as uncleanly as it is dangerous. Such food is altogether out of place at a table surrounded by human beings who wish to enjoy good health.

### **Dangers to Health from Diseased Meat.**

In order to guard the human system from injury arising from the introduction into the stomach of diseased and infected meat, a considerable acquaintance with the diseases of animals, and especially of the maladies affecting cattle, sheep, swine, and domestic fowls, is important. Foods are the great means of bringing into the human body the various parasitic worms, such as the tape-worm and the trichina; and butcher's meat, especially pork-butcher's meat, is the common vehicle for this species of infection.

The contagious fevers met with among cattle, and which are important to us from a hygienic point of view, are first, epidemic pleuro-pneumonia or lung fever, which is peculiar to horned cattle; second, aphthous fever or foot-and-mouth disease, called also the murrain, which affects horned cattle, sheep, and swine; third, small-pox in sheep; fourth, cattle-plague, the rinderpest or contagious typhus fever of cattle; and fifth, the Texas cattle fever, which has not yet been sufficiently studied, and may prove to be a form of the long-known anthrax or malignant pustule.

The anthracic or anthracoid disease called by the Germans miltzbrand, or murrain, or murrain of the spleen, includes the splenic apoplexy of horned cattle and sheep, the braxy of sheep, the black quarter, and carbuncle of the tongue, in cattle and sheep, and the various forms affecting the mouth, throat, and neck in pigs, also the blue-sickness of hog-cholera. The milk-sickness or trembles of cows, and many other less frequent or milder diseases, are to be guarded against, if possible.

The parasitic affections of animals used for food include the measles of pork, so-called, not because it has any similarity to the measles in children, but because the meat, when cut up, has a spotted or measly appearance. This kind of meat, if eaten without most thorough

cooking, is liable to produce tape-worm in those who use it. The rot of sheep and the lung-disease of calves and lambs are also parasitic maladies. But the most important of all is the trichina-disease, which, in consequence of the embargo of American pork and bacon by Germany and France, assumed in 1883 a national and political importance.

One of the greatest perils from articles of nitrogenous food in this country arises, in fact, from the want of systematic legal safeguards against the sale and consumption as food of diseased meat, and especially meat containing the immature forms of trichina, tape-worm, and other parasites of this kind. It is not yet by any means known how many of these parasites are found under various circumstances in man, and of those with which we are acquainted, it is impossible to say in every instance how they gain entrance to the human body. Of the ten or more varieties of tape-worm which have been discovered in human beings, only one is common in America; a second, called by way of distinction the broad tape-worm, is somewhat rare, whilst the rest belong rather to the curiosities of medical experience. As the symptoms of the trichina-disease and of tape-worm will be described in the second part of this work, it is only necessary to point out here the indications of these affections in the animals from which man is likely to become infected, in order to guard against the use of flesh from such creatures as food.

#### **Larvæ or Young of the Tape-Worm in Meat.**

It appears that the eggs of tape-worms generally enter the bodies of animals in which they develop from eating the excrement of human beings, or certain of the lower animals, affected with tape-worm; and, according to Dr. Thudicum, the development can only occur, in the pig, if the animal is less than a year old. Whilst the parasites are boring their way from the intestines, in which they are hatched out, to the voluntary muscles of the pig, chiefly those of the fore-part of the body, pain and symptoms of inflammation are always present. The immature tape-worms, called at this stage of their growth *cysticercæ*, are found so generally under the eyelids, and beneath the tongues of the affected animals, that the French and German inspectors examine all hogs by observation of these parts, and consider this a positive test for the presence of the parasite. The bags or cysts of the larval tape-worms lie usually in the connective tissue, between the muscular fibres of the flesh, being oval, translucent, and about as large as a pea or bean. Their duration of life in the pig or ox is nearly the same as in man, that is, from three to six years. These small bladders, scattered through the muscles, cause the appearance giving to the meat its popular name of *measly pork*, which was mentioned by the Greek philosopher Aristotle nearly two thousand years ago. The symptoms in the hog, should the affection be severe, can be readily recognized if the creature is observed with moderate attention.

The shoulders of the beast puff out and become broad, probably from dropsy; the loins grow narrow. There is nearly always inflammation of the inner surfaces of the eyelids, and often hoarseness, difficulty of breathing, and lameness of the animal. After slaughtering, the little bladders, partially filled with fluid, are readily recognized with the naked eye, unless their number is quite small or they have been shrivelled by drying. When taken into the human stomach, the walls of these cysts are digested, setting free the young larvæ, which, in a certain small proportion of instances, if still alive, become tape-worms in about two days.

The symptoms of trichiniasis, or the trichina-disease in swine, are somewhat similar to the tape-worm disease in the same animal, although the tendency to diarrhœa is much more decided, and the difficulty of breathing and of swallowing is much greater. In experiments of feeding hogs with trichinosed meat, made by Prof. Gerlach, it was shown that about two-fifths of the pigs so fed were either not affected or only slightly disturbed: the remaining three-fifths became sick, the young pigs proving much more susceptible than old ones to the infection. In the mild cases, no obvious symptoms appeared; but in the severe ones, profuse diarrhœa soon came on, with great weakness, the animal staggering along with its tail hanging loose and limp, or frequently lying down and pawing with its forefeet. Occasionally the malady proves fatal in this stage, but more frequently the disease goes on, and a new train of symptoms appear as the parasites make their way into all parts of the muscular system. The pigs become very restless, walk with a stiff or tottering gait, and eating becomes so difficult that the creature, in spite of the appetite which it evidently feels, will turn away from food. Motion of the jaws is so much interfered with, by the inflammatory swelling of the muscles which ordinarily move them, that the mouth is held closely shut for days, unless pried open for the purpose of feeding the animal. Breathing is likewise greatly interfered with, and the voice changes, becoming weak, and in very bad cases even disappearing, so that the pig does not try to squeal when disturbed. When the malady proves fatal in the hog, it is usually preceded by very great emaciation, in one instance a quarter of the weight being lost before death. About one-half of the severe cases prove fatal in swine, but those that recover soon grow fat again, and apparently regain their health. But even where no symptoms appear, or the health is only slightly disturbed after feeding with infected meat, the flesh of the animal is found to contain parasites enough to render it a dangerous article of human food. After severe sickness, the infection of the meat in hogs which recover is nearly always considerable, so that the small quantity of half an ounce may contain from fifteen to twenty thousand trichina, and readily prove fatal to a human being who eats it.

Although a knowledge of these symptoms of trichiniasis in the hog may serve to guard the reader against the possibility of such dangerous



infection, the only security against it is in a thorough microscopic examination of the pork before it is consumed as food. Such an investigation is made in the German Empire by nearly fifteen thousand government inspectors, who usually search the diaphragm or midriff, the muscles between the ribs, and those about the jaws, of every animal offered for sale, because these are the parts most apt to be affected.

The meat of cattle suffering from pleuro-pneumonia or from foot-and-mouth disease, or that of sheep dying from braxy, is claimed by some authorities to be safe, although it would be far better never to allow it to be used as human food. There is, however, little or no difference of opinion respecting the danger of meat from animals affected with splenic fever. Prof. Gamgee states that he has known bullocks diseased in this way to be slaughtered, and afford beef which, to all appearances, was as fine as any butcher could show, nevertheless dogs, pigs, and ferrets died from the effects of eating it, and horses have died from drinking water contaminated with the blood from such cattle. This virulent affection, identical with the *Miltzbrand* of the German, and the *Charbon* of the French, gives rise in man to the terrible malignant pustule, which sometimes proves so quickly fatal to butchers, and even to men who handle the hides and hair from sick animals. When this malady proves fatal to cattle by producing splenic apoplexy, as is frequently the case, the rest of the carcass may appear perfectly sound, and yet be exceedingly dangerous as an article of diet. Dr. Fox mentions that, a few years since, a carrier was packing some diseased meat of this kind for the London market, and a splinter of bone entered his hand; the poison thus introduced caused phlegmonous erysipelas, which ended speedily in general blood-poisoning, terminating his life in a few hours. In another instance, a man was engaged during a dark night in resurrectionizing a diseased animal, which had been buried; he hoisted some of the meat in a sack over his back, which was alone covered with his shirt. In some way or other the juices of the meat passed through the bag and the shirt, coming in contact with the skin of his back, where the cuticle was probably rubbed off in some little spot; through this tiny opening the poison doubtless made its way. Erysipelatous inflammation, attended with intense depression of the vital powers, rapidly set in, and the man soon expired.

Large quantities of the meat which is offered for sale in most city and many country markets come from animals affected with consumption of the lungs or bowels, called by cattle dealers the "grapes." In the early stages of the disease the flesh does not present any of the characteristics of bad meat, and until quite recently its sale, even in the strictly guarded London markets, was not interfered with. The late experiments of Dr. Koch, the celebrated president of the German Imperial Board of Health, indicate so strongly the contagiousness of consumption in all its forms,

that such meat should be carefully avoided as far as possible. Since it is estimated, by competent authorities, that only one-fourth of the cases of consumption in the human race can be traced to hereditary influence, it has long been supposed by medical philosophers that there must be some as yet undiscovered cause, predisposing to the formation of tubercle, which, acting in concert with the great exciting cause in our climate of atmospheric vicissitude, determines the advent of consumption, in many of the instances which go to make up the remaining three-fourths of the mortality from this fatal malady. By direct experiment, this kind of infection has been proved to occur in calves, from eating portions of tuberculous lung from a cow; and the probability that human beings have often been infected in a similar manner is therefore very great. Nor is this dangerous infective quality confined to the meat of diseased animals alone, for Bollinger asserts that he has found that the milk of such creatures has a pre-eminently contagious character, and reproduces tubercular disease in others to which it is administered. According to his experiments, boiling the milk does not always destroy its injurious properties in this respect. Even the breath of tuberculous, that is consumptive, cows appears to be dangerous, as is indicated by the observations of Dr. Grad, of Alsace, who, on visiting a farmer in his neighborhood, was informed that annually, for five years, one of his cows had died of consumption in a certain stall. In order to test the question of a local infection, Dr. Grad, with the consent of the owner, selected a vigorous three-year-old heifer, of perfectly healthy pedigree, and placed her in the supposed fatal stall. For a time the animal continued well, but after calving a slight cough set in, and this gradually increased; emaciation took place, and, when inspected a year later, the creature was a mere shadow of her former self, and presented all the symptoms of advanced consumption. In this instance the poor beast was no doubt infected by breathing and swallowing particles of infected matter coughed up on the manger by her predecessors in the fatal stall.

It is the practice in the city of London for the inspectors to condemn the flesh of all animals infected with parasitic disease, such as measles, liver flukes, trichina, and so forth, of animals that have been sick from any acute febrile or wasting diseases, and of those which have died from natural causes, as well as meat tainted by physic of any kind, and that in a high state of putrefaction. To this list might well be added the flesh of all animals which have been over-driven or wounded before death, whether by slaughtering or otherwise. It is also customary to condemn the meat of any animal which has been killed before, during, or immediately after calving, on the ground that a cow would not be slaughtered under such circumstances unless, from some cause or other, death appeared to be impending.

When diseased or putrid meat has been condemned as food, care should



be taken to prevent its being dug up after it is buried, and sold in some such form as sausage. This may best be prevented by impregnating it with certain chemical substances. In London, where sometimes vast quantities of meat, for instance, one hundred oxen or thirty-five tons of flesh, are seized in a single day, the condemned meat is plunged into a huge tank, filled with a solution of sulphate of iron, picric acid, and other ingredients, which give the flesh such a black color and nauseous taste as to remove all fear of its ever being used for human food. On a smaller scale the same object may be accomplished by cutting numerous deep gashes into the carcass of an animal, and filling them with impure carbolic acid, kerosene, or oil of turpentine.

As general rules, the following suggestions of Dr. B. W. Richardson are worthy of being committed to memory by everyone: All specimens of animal food which present signs of being spotted or speckled should be rejected. If in the flesh small, rounded, white spots be observed, the meat should be rejected. If connected with a portion of the flesh there be minute bladder-like structures, the substance should be rejected. If the meat, especially pork, present what is called a measly appearance, or as it is sometimes commonly described "a pepper and salted look," in lines or sections, it should be rejected. If it presents the appearance of anything living in its structure, it should be rejected. The greatest care should be taken that all foods, whether animal or vegetable, be thoroughly clean before they go through the process of cooking, if they are to be eaten cooked. Still greater care ought to be taken with those articles of food of a vegetable kind, such as celery, radishes, onions, and the various sorts of fruits, which are intended to be eaten uncooked. With children, unclean fruits are a constant cause of disease, particularly of that parasitic disease produced by thread-worms. It is also probable that the large round worms are often introduced into the human system by their eggs being eaten with unwashed fruit and vegetables. When the intestinal parts of animals are used as food, as is the case with tripe, too much care cannot be taken in regard to cleanliness. Such foods are of doubtful propriety altogether; but if they are to be utilized, it should be with more than ordinary preventive care. The same rule applies to the liver, which is an easy channel as food for the propagation of disease among those who subsist upon it.

In regard to every kind of animal and vegetable food that may be the means of conveying parasitic forms of life into the human body, there is another rule which should be universally adopted, and that is to have such food thoroughly and completely cooked. No animal food ought to be eaten that has not been subjected to the temperature of boiling water, that is to say, to a heat of  $212^{\circ}$  Fahrenheit. It should be subjected to this temperature throughout the whole of its structure, whether it be boiled or roasted. It is probable that all the parasitic forms of life are



destroyed at this temperature of  $212^{\circ}$ , and the actual fact of complete boiling is itself a valuable preventive; but roasting, when effectually carried out, is a still better safeguard. To effectually roast a piece of meat, however, it must be cooked entirely through, so that the eggs and embryos of parasites deep in the interior are all destroyed by the high temperature. That roasting, as ordinarily performed, may often fail to accomplish this, is evident from the fact that the change from red to brown, in a piece of roast beef, for example, is caused by an alteration of the red blood corpuscles, which occurs at a heat of  $149^{\circ}$ , and yet it is quite common to see upon the table a sirloin which is brown or even burnt upon the outside, and yet red or rare only an inch or so beneath the surface when it is carved. Wherever a piece of meat of this kind is still rare inside, it may yet contain the living eggs or embryos of the dangerous parasites, notably tape-worm or trichina, and the tiny red corpuscles thus become for us useful little thermometers, as it were, indicating with certainty that the meat in which they still remain red has not yet been cooked sufficiently to make it safe for us to eat. No more conclusive proof of the value of good cooking, in protecting persons from the trichina at least, could be found than in the history of the trichina-disease in the adjoining countries of France and Germany. In the latter, as the direct consequence of the national custom of eating raw or under-done meat, in various kinds of sausage, thousands of cases and hundreds of deaths from this malady have occurred; whilst in France, where the cooking is well known to be the best in the world, according to the report of a recent commission, not a single citizen has lost his life from trichiniasis during the past ten years.

### Methods of Preserving Nitrogenous Foods.

Various plans have been suggested from time to time for preserving the proteid elements of human diet, which, as a rule, are perishable, and offer great difficulties in the way of keeping a continuous supply. Remembering, however, that from half an ounce to an ounce of nitrogen and from eight to twelve ounces of solid carbon are required every twenty-four hours, and that these must be associated with some other animal or vegetable ingredients in order to be digestible and acceptable to the stomach, we can scarcely expect or even hope that any food can be prepared which, in less quantity than twenty ounces, no matter how dry it is, will be capable of sustaining a man's life for any great length of time. For a few days, indeed, it may answer admirably; but, as shown by Dr. Parkes, in experiments on himself, when he reduced the amount of water-free food to eleven ounces daily, although he could fully retain his strength for seven days, his body was constantly losing weight. Dried and powdered meats, such, for example, as the favorite English preparation, Hassall's flour of meat, and the pemmican, which is a dried mixture

of beef and fat, used by the Arctic voyagers, with many other contrivances, have all had their advocates; but the one most used at present is probably Liebig's extract of beef. This substance, when genuine, is prepared by heating the meat *in vacuo*, so as to avoid the injurious effects of an elevated temperature, and represents the pure juice of the meat. Mixed with water, this material gives a highly nutritious beef-tea, or if it happens to be extract made from the carcass of a sheep, mutton broth. Its flavor is, unfortunately, so suggestive of a glue-pot that many persons find it exceedingly distasteful; but where this disagreeable taste can be ignored or concealed by the aid of pepper and other spices, its value to sick or even to merely delicate adults, and especially children, is very great. Most of the extract comes to our markets from South America and Australia, and it is claimed that the contents of a two-ounce jar represents the virtues of about five pounds of meat. This, however, is denied by some physiologists, who assert that it is worthless as an article of food, and only acts as a stimulant to the heart, in consequence of containing certain salts of potash; but by supplying these, and some others of its constituents, it must at least aid nutrition, even if we suppose its nitrogenous principles are useless, which cannot be considered as at present proved. When taken in solution during or after great muscular exertion, it is found by a great many people to be remarkably restorative, increasing the power of the heart, and removing the sense of weariness following violent muscular exertion. About half an ounce of the extract in a pint of water makes a liquid nearly equal to a pint of beef-tea, prepared from two-thirds of a pound of beef. There is a general opinion among physicians that the extract beef-tea is not so good as that made at once from fresh beef, but some persons prefer the solution of extract, and find its restorative power quite as great; others eat the extract itself, with or without salt and pepper, and experience highly beneficial effects.

#### Hygienic Value of Fish.

Fish is by no means an unimportant article of diet, and a very large number of species, both fresh- and salt-water, contribute to the nourishment of man, affording great and agreeable variety to this kind of food. In some parts of the world, and particularly as we approach the polar regions, where the intense cold of winter is unfavorable to the multiplication of land animals, fishes constitute by necessity the chief or the sole nitrogenous food available for the inhabitants. In Siberia, fish, after being dried, is ground into powder, and made into a substance which is used instead of bread by a large part of the population of that frigid country. Putrid fish is even, we are told, the favorite and ordinary food of some savage tribes. Although from time immemorial fish has been used as an aliment by mankind, many prejudices formerly existed in regard to it. The Egyptian priests were forbidden to eat fish of any kind, under the



idea that it stimulated the carnal appetites, and was also the cause of leprosy. For the latter reason the Jewish people were forbidden to eat fishes which were not covered with scales. A scaleless fish is recorded to have been the cause of the death of King Henry the First of England, who got a surfeit, according to the old chroniclers, and died from eating too heartily of lampreys, a food against which he had often been cautioned. The experience of a great many people, indeed, shows that fishes are sometimes endowed with an almost poisonous quality, especially in tropical climates. Some varieties appear to be deleterious at all times, and others to be capable of injuring the health only at particular seasons of the year, or under certain conditions not yet well understood. The symptoms produced by eating poisonous fish often resemble those of cholera, and a kind of nettle-rash is also frequently occasioned. Occasionally the nervous system is powerfully affected, and various disturbances, such as convulsive twitching and trembling of the limbs, partial paralysis and stupor, are produced. It is not definitely known as to what principle, if any, the deleterious effects of poisonous fish are to be ascribed, and they have been variously referred to the aliment upon which the creatures have fed before being caught, to their being in a diseased condition or infested with parasites, to putrid decomposition, or to some idiosyncrasy upon the part of the person affected. A fish is popularly said to be suspicious if it has attained an unusually large size, or is destitute of the natural fishy smell, or has black teeth, or if a silver coin boiled with it turns black; but all these tests are unreliable. It has been asserted that heaviness and uneasiness of the stomach are particularly apt to be produced by fish if they are eaten with acid fruits or jellies, and that milk is a very improper article to be used at the same time with fish, frequently causing severe cholera morbus, diarrhœa, or other disorders of the alimentary canal.

As an article of nourishment, fish does not possess the satisfying and stimulating properties which belong to the flesh of quadrupeds and birds. Still the health and vigor of the inhabitants of many fishing towns, where fish constitutes the only kind of animal food which is eaten, prove conclusively that it is capable of supporting life, and maintaining the physical forces of the human body in their full integrity. Dr. Davy asserts, indeed, that the fish-eating or Ichthyophagous group of mankind are especially strong, healthy, and prolific, and that in no other class do we see larger families, better developed women, or more robust and active men. As a less stimulating and more digestible article of food than meat, fish possesses some valuable properties in the treatment of disease and of convalescence, and is constantly being employed with advantage, when the assimilative powers are too weak for the stronger kinds of animal food to be borne. The flesh of some fish is white, whilst that of others is pink or red: the former is less stimulating and lighter to the stomach, that is to say, more digestible, than the latter. Amongst those having white flesh



are the shad, cod, haddock, turbot, and flounder. The flesh of the salmon presents a strong contrast in its color to those of the fishes just enumerated, approximating to meat in redness, and resembling it also in its sustaining properties more than a majority of other members of the finny tribe.

Shell-fish, such as oysters and clams, also lobsters and crabs, yield a less nutritious kind of food, and the latter two, with their allies among the smaller crustaceans, whilst looked upon as choice articles of diet, prove very indigestible to a majority of people who eat them. Oysters form an attractive food, and although much less nutritious than meat, are far more digestible. The story of an oyster being digested in its own liquid when placed in a glass of beer is, however, a supremely foolish one, and whilst they can be assimilated by the stomachs of most people in very weak conditions, if swallowed in a raw state, some gastric juice is unquestionably necessary for their solution. When thoroughly cooked by boiling or panning, they are rendered much less digestible, and broiled oysters, though perhaps not more difficult to digest, are dangerous, because, being more tempting to the palate, they are apt to be partaken of to greater excess. Fried oysters are exceedingly unwholesome, and probably derange the stomach and bowels in a larger percentage of cases than almost any other rich dish in common use. It is particularly important, in regard to oysters, and in fact to all of these shell-fish, not to partake of them out of season, and a favorite piece of advice respecting diet is, "eat oysters only in the months which have an R, and drink whisky only in those which have a K in their names." It is better for invalids and those endowed, or rather cursed, with delicate stomachs, to reject the hard part, or eye, as it is called, when eating oysters, as this portion, being composed of the powerful muscle, by the aid of which the mollusk closes its shell, is much denser, tougher, and therefore harder to digest in the stomach. Crabs and lobsters, although considered such great delicacies, are to most persons highly objectionable articles of food. When partaken of in small quantities, they are very apt to bring on heartburn, acrid eructations, an uneasy feeling of heaviness at the pit of the stomach, and colicky pains in the abdomen; and when eaten to excess, they often produce violent attacks of cholera morbus, and have been known to give rise to dizziness, stupor, and other symptoms of apoplexy, which in rare instances have gone on to a fatal result. Whether from idiosyncrasy on the part of the person affected, as is doubtless often the case, or from some noxious properties developed in the individual animals eaten, the partaking of shell-fish is particularly liable to be followed by eruptive disorders of the skin, and especially by nettle-rash. So strong, indeed, is the tendency in some people to have such cutaneous affections developed, that it is occasionally necessary to scrupulously exclude all kinds of shell-fish from the diet; but there are many persons who, in health and even in sickness, find in

raw oysters, and in oysters very slightly cooked by roasting or boiling, one of their most agreeable and acceptable articles of food.

### Hygienic Considerations in Regard to Milk.

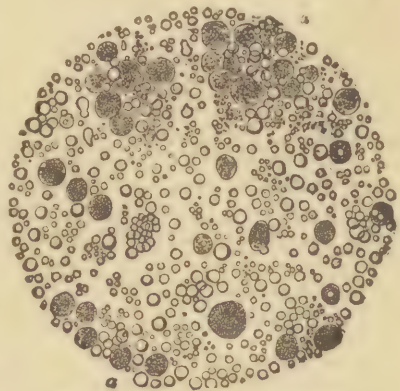
The importance of milk as an article of food, together with the ease and alarming extent to which it is adulterated, and also the great danger of typhoid or other infection from impure milk, renders it worthy of most attentive study from a sanitary point of view.

Milk contains representatives from all four of the groups of alimentary substances; but being intended especially for feeding young animals during growth, the proportion of proteids and of fats is large as compared to the saccharine constituents. The composition varies in different species of animals, and also under conditions, to be hereafter pointed out, in various animals of the same species. The analysis of cow's milk, with which we are most interested, has already been given on page 138. In order to furnish an adult man his twenty-three ounces of water-free food daily, eleven pints of average milk would be needful—a quantity too great for most stomachs to bear; but for infancy and childhood it is, as most people can testify, singularly agreeable and appropriate. It was formerly believed that milk was an exudation from the blood, but recent investigations tend to show that it is produced by a fatty degeneration of the epithelial cells of the milk-glands. Hence it is now defined as cell-structure made fluid, so that every suckling animal is in reality a cannibal, which consumes the milk-gland organs formed out of the blood of the nursing mother.

In Fig. 29 is shown the microscopic appearance of a drop of milk, displaying at *a a* some of these fatty cells from the milk-glands. In human milk, these cells, called colostrum corpuscles, are very abundant at first, but soon disappear as the function becomes fully established.

The chief sanitary interest in a detailed analysis of milk is practically in regard to human milk and cow's milk, although goat's milk is also employed to some extent as food. Goat's milk differs from cow's milk, especially in containing a larger amount of fat, which is sometimes present to the quantity of nine per cent., and its casein or cheesy ingredient coagulates in large clots. It has, however, a peculiar taste, which causes many people to dislike it. Sheep's milk is one of the most dissimilar from human milk, but is used for food by man in some of the mountainous dis-

FIG. 29.



HUMAN MILK CONTAINING COLOSTRUM CORPUSCLES.



tricts of southern Europe and elsewhere. Mare's milk is used by the Tartars to manufacture their koumiss, which has of late acquired such a reputation in some parts of the United States in the treatment of certain chronic diseases. Asses' milk is used in France as a substitute for human milk with children. It approaches more nearly to human milk in chemical composition than some of the substitutes for mother's milk, but is more dilute, containing a smaller proportion to its bulk of the nutritious proteids and fatty matters. Dogs, cats, and other carnivorous animals afford a milk richer in proteid elements, but the kind of food eaten by the creature has a greater effect upon the quality of the milk than is the case with the herbivorous animals. Elephant's milk, which was obtained for the first time in America in 1882, is a curiosity on account of its enormous richness in fat, which causes it to approximate to the condition of cream, and it is also relatively richer in sugar.

The souring of milk is due to the formation of lactic acid, from the lactine or sugar of milk which it contains, by a process of fermentation. This change is believed to be effected by the growth of innumerable minute fungoid plants, which can be readily seen under a high power of the microscope.

#### **Diseases Caused by Impure and Polluted Milk.**

The diseases produced by adulterated milk are, of course, mainly those of debility and commencing starvation, such as have been already described when speaking of the results of partial deprivation of food. There is, however, as already intimated, a consequence of certain impurities in milk, connected with its contamination in some way with the poisons of contagious disease, which is so important, and at the same time so little understood and guarded against, even by physicians, in many parts of the country, that special attention should be directed to this dangerous mode of conveying fatal typhoidal, scarlatinal, and diphtheritic disease. Besides these perils, the great importance of a study of milk adulteration from a hygienic point of view, practically turns upon the concealment of the impoverishment of the milk, and the consequent palming off of a poor article of food for a good one, constituting a fraudulent depreciation of value in one of the necessities of life, and especially of infant existence. Those who know its real deterioration can easily provide accordingly, by taking more of it if it is poor, or making up for the deficiency with other food. If they pay the usual price for good milk, they will not get the worth of their money; but the fault in this case is at least partly their own, for they purchase knowingly a poor article at a relatively high price. But a mother who is ignorant that one-half or one-third of the substance of the milk she uses for her baby has been stolen, may be starving her child without knowing it. It may become sick, or even wasted with diarrhoea and dysentery, which, as already explained, are the common



symptoms of incipient starvation, whilst she remains totally ignorant that this poverty of the milk is the sole cause of the poor baby's sufferings. Most physicians are well aware that one of the chief dangers to children in their second summer, especially among the poor in large cities, is death from cholera infantum, and it is extremely probable that much of this deadly disease is brought on by a want of sufficient nourishment in consequence of using impoverished milk. Yet poor people will often be tempted to buy the inferior article of milk, knowing it to be diluted, because they are unaware of its disastrous effects upon the health of little ones. As an illustration of how much good can be accomplished by guarding the purity of even a single article of food, it may be mentioned that the New York City Board of Health has, by its operations—prominent among which are the obstructions its members have been able to put in the way of the sale of adulterated food, and especially of impure milk—reduced the annual mortality of children under five years of age from fifty-three to forty-eight and a quarter per cent. This is equivalent to saving the lives of about three thousand children annually in that city.

In studying the frauds too often practiced upon the community by milkmen, it is obvious at the outset that, whatever substance is employed for adulterating milk, it must fulfil certain conditions, or else its presence will be at once detected. Thus it is essential that any material added to milk for the purpose of adulteration should be perfectly soluble in the fluid, otherwise it would either rise to the surface or be precipitated to the bottom of the vessel, on standing, in the form of a sediment. It is, moreover, important that the substance made use of should not become coagulated on boiling, nor possess any peculiar taste, odor, or color, which would be communicated to the milk and thereby modify or interfere with its well-known and conspicuous properties, thus betraying the sophistication. Now the substance which best answers these indications is water, and there is, therefore, a great probability that this will be the agent generally chosen as an adulterant, and that any other material added will be employed with the design of concealing the effects produced by water-dilution, with the single exception of carbonate of soda, which is added with the idea of preserving the milk, or of hiding its acidity after it has begun to turn sour. When examinations of milk were first commenced, a great variety of ingredients were found in the sophisticated fluid. Thus, flour or starch, gum arabic or dextrine, chalk or whiting, turmeric, annatto, gum tragacanth, sugar, arrowroot, emulsion of almonds or hempseed, eggs, and salt are all reported to have been used to adulterate milk, but at present it is probable that sugar or glucose is the only one of this list in common use.

If water alone be added to milk, the specific gravity of which is about the average of 1029, water being 1000, the density of the mixture will

necessarily be lowered; and if adulteration were practiced only in this way, it could be at once detected, by testing with the instrument called a hydrometer, which, as most people are aware, shows the specific gravity of a fluid into which it is dipped. Hydrometers specially adapted to testing milk, and hence called lactometers, are sold, with jars to float them in, by most dealers in chemical apparatus. It would be well for every mother to examine in this way the milk with which she sustains her children, but she must be careful not to rest entirely satisfied with the favorable verdict of such an instrument. The truth is, if a lactometer indicates adulteration with water to any considerable extent, its evidence is entirely trustworthy; but its testimony in favor of the purity of milk is not equally reliable, because the milk may be sophisticated with a solution of sugar having the specific gravity of 1029, without any possibility of the fraud being detected by any form of the hydrometer. Milk so adulterated could, however, be detected by examining it with the creamometer, which is a tall jar or long tube divided into a hundred parts, in which the milk is allowed to stand twenty-four hours in order to allow the cream to separate. A good milk ought to send up a layer on the top of the fluid occupying from eight to twelve of the one hundred divisions, and representing of course eight or twelve per cent. of cream. A lower percentage of cream indicates dilution of the milk. Another valuable instrument, called the lactoscope, is so constructed as to show how great is the opacity of the milk, by determining how much dilution it will bear before certain objects can be distinguished through a layer of definite thickness. For absolute certainty, however, a resort must be had to chemical analysis, so far as to determine the amount of total solids, the quantity of fat, solids not fat, and of ash, after combustion of the solids, obtained by evaporating the suspected sample of milk to dryness. The amount of ash represents, of course, the mineral ingredients of the fluid.

A very good idea can be obtained, in the absence of instruments for testing milk, with the exception of the lactometer, by merely inspecting the sample as poured out in a thin stream, looked at against a dark background. Indeed, the New York inspectors are reported to rely chiefly upon this method. In examining for adulteration in this way, it is necessary to remember that genuine milk may vary a good deal in its constitution, not only in different cows, but in the same cow at different times. These variations may depend, first, on the breed of the cow, the Alderneys giving milk which is especially rich in cream, whilst the Durhams contain a larger proportion of casein; secondly, the number of calves makes an important difference, less milk being given with the first calf than with subsequent ones; thirdly, the time which has elapsed since the last calving, for during the first week or ten days after the birth of the calf a yellow, thick, and stringy milk called colostrum is secreted, which is often quite unfit for use. A fourth important condition modifying the character



of the milk is the kind of food furnished to the animal. Although the chemical constituents of milk are remarkably little affected by the cow's diet, provided a full allowance of nutritious matter is supplied, yet it has been found by experiment that, when cows are fed on carrots or beet-root, the casein and butter of the milk are diminished, and that of the sugar is increased. On the other hand, the food furnished may not afford a sufficient amount of nutriment, in which case a diminished quantity of milk of a poorer quality is produced. Or, again, the food may be of an unnatural character, such as distiller's grains, which cause the milk-producing organs to be unnaturally stimulated, and a large amount of deteriorated milk is yielded. If the food consists of the refuse of distilleries, or of garbage in the well-named swill-milk dairies, as is too often the case near large cities, the animals soon become extensively diseased; and, although the appetite may remain unimpaired, the milk given is manifestly unfit for use, and its sale has been very properly condemned in some places by legislative enactments.

Milk has been found to possess an unpleasant sweet or bitter taste, and a rotten, disagreeable odor, when supplied by cows which are badly kept on damaged forage and filthy water, or allowed to stand in dirty, unwholesome, or damp stables and dairies. Mr. Smee exposed milk to sewer-gas, but could find no change in its composition on making a chemical analysis. On distilling the milk, however, at a temperature not exceeding 120° Fahrenheit, a distillate was obtained which had an unpleasant taste and a disagreeable smell. The tasting of this distilled liquor by the experimenter brought on intense headache, with a vigorous, rapid pulse, and was followed by severe diarrhoea. Milk exposed to the vapor of animal matter undergoing putrid decomposition, when similarly treated, yielded a product which was also offensive and dangerous to health. When milk coagulates during or immediately after milking, especially if it be slightly warmed, it is generally due to acidity, which may be caused by inflammation of the udder, or by digestive disturbance, and a febrile state of the animal yielding it.

#### **Yellow, Blue, and Green Milk Unwholesome.**

When milk has a yellow color, it may be so tinged by the colostrum of newly-calving cows, or it may result from irritation or congestion of the udder. Some dairymen color their milk with annatto to give it a rich appearance, and in such instances this coloring matter may be recognized by its remaining in the whey after the milk is boiled. An unnatural yellow tint in cream is sometimes produced by the growth in it of a microscopic organism. The eating of orchids by cows is said to sometimes give a yellow hue to their milk. A kind of viscid milk, which is stringy and like mucus, when poured from one vessel to another, and the taste of which is stale and unpleasant, has been found to contain an



unnaturally large proportion of albumen, and also of carbonate of ammonia. Microscopically it resembles colostrum, but is distinguished from it by its power of producing the same alteration in a large quantity of healthy milk. This viscosity has been supposed to be due to a half-starved condition of the cows and to unwholesome dairies.

The colors of blue, red, and green milk and cream are all probably due to the development of minute vegetable organisms, the exact nature of which has not yet been sufficiently studied. The ferment produced will give rise to the same alteration, when a small portion of either of these altered fluids is added to a large quantity of good milk. There is, therefore, little doubt that the processes are similar to that which takes place during the fermentation brought about by the growth of the yeast-plant, and that all are due to the development of a microscopic plant of fungoid type. Blue milk has a disagreeable taste, and has been found to produce diarrhoea and severe inflammation of the stomach; pigs, rabbits, and calves also suffer from diarrhoea after feeding on it. A distinction has been made between milk that is blue when first drawn from the cow, and that which is blue only when coagulated, or in the condition of cream, the former being supposed to be innocent and the latter injurious to health. The probability is that this blue color is due to one and the same microscopic organism, which becomes poisonous only at a certain stage of its development. The blue color of milk may, however, in some instances, be attributable to the cows' eating of certain plants which have a bluish tint.

The milk of cows suffering from foot-and-mouth disease has been found to convey the infection to pigs fed upon it in a few hours. In human beings, aphthous and herpetic patches of eruption, followed by sores and sometimes accompanied by diarrhoea, have been ascribed to the use of such milk. These symptoms are, of course, chiefly observed in children, partly because they are the chief consumers of milk, and partly because their delicate organizations are more susceptible to infectious diseases. The condition of the milk varies very much, according as the udders are more or less affected. Sometimes it appears quite natural, and at others it is red, brown, or yellow, from the presence of blood and corruption, or it may be ropy, fetid, or partly coagulated. In a large number of instances, the milk of cows undoubtedly affected with foot-and-mouth disease has been used without any obvious evil result; but it is certainly safer to avoid such milk, and, when compelled to employ it, to do so only after thorough boiling.

#### **Diseases Conveyed by Milk.**

The inquisition which sanitarians are ceaselessly prosecuting into nature's methods of propagating disease, has seldom been rewarded with a more valuable discovery, in a more unpromising field, than that in

regard to the portability of certain common infectious maladies which plague mankind by means of milk. The peculiar readiness with which milk absorbs disagreeable odors and flavors has long been a matter of popular observation, but it is only within the past twelve or fourteen years that its power of taking up the germs or disease-poisons of several of our contagious affections, and transplanting them from their original site to the congenial soil of some uninfected human organism where they can flourish with renewed vigor, was detected. Doubtless much of this capacity for evil which is possessed by milk is due to the very fact already alluded to, of its obtaining access to infants and young children who have not been protected by previous attacks of scarlatina or typhoid fever; but its chemical composition, being that of a dilute watery solution of complex nitrogenous matter, renders it highly favorable for the growth of low organisms, so that, accepting the germ-theory of disease, the natural composition of milk peculiarly fits it on this account for the extension of its malevolent sphere of influence. At any rate, there is no question that more than two-score of localized epidemics of typhoid fever, scarlet fever, and diphtheria, some of them affecting hundreds of individuals, the origin of which would otherwise have been shrouded in mystery, are now satisfactorily traced to dairy farms, occasionally many miles from the scene of their deadly operations. In most instances, the milkmen have strenuously denied that any typhoid-fever poison could possibly have found entrance to their milk from the wells in which it was proved to have existed, except during the process of washing out the milk cans; but knowing as we do, and as has just been pointed out, how profitable and how difficult of detection is the adulteration of milk with sweetened water, to a moderate extent, it requires all an optimist's faith in poor humanity to give credence to their statements.

Only a year or two since, at Southport, England, one case of typhoid fever after another was announced to the municipal authorities, until, in about two weeks, a total of twenty-eight was reached. Such a rapidly-invading epidemic demanded, of course, energetic measures for its repression, and a careful inspection of the various dwellings in which the victims had been attacked was undertaken. The health officers found, however, to their surprise, that with two trifling exceptions the premises were all in good sanitary condition; but further investigation disclosed the fact that, in every instance, milk had been served to the families in which typhoid fever had occurred from a particular dairy some miles distant, and upon the grounds of the dairyman in charge of this establishment was discovered a well horribly polluted with soakage from a filthy cess-pit near it. In the words of the chief health officer, chemical analysis showed that it was nothing but liquid sewage, and calculated to spread disease wherever its influence extended. The proof that this foul infecting material had been accomplishing the work for which it was so well "calculated," is met



with in the circumstance that, on stopping the milk-supply from this dairy, the epidemic ceased to spread, although not before two of the cases previously attacked had resulted fatally.

### **Scarlet Fever and Diphtheria from Milk.**

The infectious material, when scarlatina and diphtheria are conveyed by milk, probably falls into the fluid whilst standing in open vessels, or is rubbed off attached to the epithelial scales of the epidermis, during the process of milking, in such a way as to gain access to the milk. In an example of this kind, recently the subject of judicial action in England, a medical officer of health stated before the magistrates that seven cases of diphtheria had occurred in his own practice, and that during inquiries made for the purpose of tracing the origin of the disease, he had heard of other instances, all of which, as well as his own, had been supplied with milk from the same establishment. Acting upon this hint, he proceeded to examine the dairy from which the milk was obtained, and found that a child was dying from malignant diphtheria upon the premises, so that this case was, it seemed highly probable, the starting-point of the whole outbreak. Still another fresh illustration of these dangers from milk is reported from the town of Dundee, in Scotland, where an extended epidemic of scarlet fever is stated to have arisen among families supplied from two particular dairies. On careful investigation, scarlatina was found to have been actually prevailing in the families of the dairy-men having charge of these establishments, before and at the time the other cases made their appearance.

It is to be hoped that, in order to obtain reasonable security against this form of poisoning, the example of our English cousins will before long be followed, and a system legally inaugurated for the thorough inspection of dairy farms, dairies, and cow-stables, having special reference not only to the health of the animals and their care-takers, but also to the state of the wells from which the water used for washing out the milk-cans, pails, and so forth, is derived. It is only too common, unfortunately, in this country, to see, even on well-kept farms, the water-supply for these and similar purposes obtained from the barn-yard pump, which, for convenience in cold weather, stands under the cow-shed or inside the farm-yard, where it is at all times liable to furnish liquid dangerously contaminated with excrement from both man and beast. As a substitute for such legal supervision, the most feasible plan would probably be for townspeople to unite together into limited associations, which could employ experts to investigate and keep watch over the sanitary surroundings of dairy farms patronized by their members. Although such undertakings might at first be rather expensive, yet when the mere cost of a dozen cases of typhoid fever is considered, there is no doubt that the outlay would be a truly economical one, even if looked at from a pecuniary point of



view only, without estimating the far more important saving of human life and suffering. In cases where such co-operative societies could not be organized, or whilst travelling, it would be advisable to use only milk which had been thoroughly boiled for a considerable length of time. In a paper read before the London Medical Congress in 1881, it was stated that the number of epidemics of typhoid fever recorded up to that time as being due to impure milk was fifty, of scarlet fever fifteen, and of diphtheria seven. The total number of cases of disease occurring during epidemics from infected milk was, in round numbers—typhoid fever, 3,500; scarlet fever, 800; and diphtheria, 500. When it is remembered, concludes Mr. Hart, that barely ten years ago we were utterly ignorant that milk could be a carrier of infection, and that consequently these epidemics have all developed in a single period of ten years, and were doubtless preceded by a multitude of similar outbreaks, the cause of which was totally unrecognized, it will be seen at once how vitally important is the safe guarding of all milk-supplies from contamination.

#### **Butter and Cheese as Articles of Diet.**

The separation of butter from milk, and its consumption as an addition to starchy food, is so universal in all parts of the inhabited globe, that it forms an admirable illustration of the way in which mankind has been guided by natural instinct, in early ages of the world, to do that which scientific investigation, and especially chemical analysis, has long afterwards shown to be most conducive to his health and happiness. The cereal grains which comprise the staff of life have the one great fault, as articles of diet, that they are poor in fat; and to remedy this, all the world over from the earliest times, cattle have been kept, and cream or butter from their milk has been utilized, to make up for the deficiency of bread in this important element of food. Butter supplies many persons with the largest amount of fatty material which they take into their stomachs, and is consumed in this country to the average quantity of nearly two ounces daily. Most people digest butter in moderate amounts quite readily, except when it is becoming rancid, in which case it is apt to produce dyspepsia and diarrhoea. Butter has mixed with it from five to ten per cent. of water, and it also contains generally a small amount of casein or cheesy matter. The rancidity of butter is chiefly owing to changes in the fat, produced apparently by alterations in this casein, and therefore the greater the amount of casein, the greater the danger that rancidity will occur. The method of testing butter is to melt it in a water-bath, examining its melting-point very carefully by means of a thermometer. Good butter begins to melt at from sixty-five to sixty-eight degrees of Fahrenheit's scale, and is completely melted at from eighty to ninety degrees. Lard, beef-dripping, and mutton-suet have decidedly higher melting-points.

The adulteration of butter is chiefly with lard and suet, in the form of the much discussed oleomargarine, although it is said to have been also sophisticated with horse-fat, vegetable oils, and starch. There can be no question but that oleomargarine, obtained from suet flavored with a small amount of real butter, and colored with annatto, is largely sold for genuine butter of inferior grades, both in this country and in Europe; but the accounts of the manufacture of butter from refuse fat, and even filthy scum, are newspaper stories invented simply for the purpose of astonishing and horrifying the public. Some good test for the purity of butter is, however, very desirable, although Prof. Chandler reported to the New York Board of Health, as the result of his inquiries into the subject of oleomargarine, and personal examination of the product and the process of manufacture, a few years since, that it was superior in all respects to the poorer grades of dairy butter sold in the New York market. Further, that there was nothing objectionable either in the material itself nor in the manufacture, and that, the substance not being unwholesome as so prepared, he perceived no need of legislation in regard to oleomargarine as far as regarded the public health.

The properties of cheese differ with the relative quantities of cream and of casein which the different kinds contain, and also in accordance with the modes of preparation to which they are subjected. The fresh, that is unsalted, cheeses, such as the cream cheese of our own country, and the fresh Neufchâtel cheese, are very nourishing, and are usually digested with comparative ease. The older and more or less decomposed cheeses, such as Gruyère, are digested with difficulty, but have the advantage of acting somewhat as condiments and promoting the digestion of other substances in the stomach. Hence the old saying, "Cheese is a surly elf; digesting all things but itself." Sometimes old cheese seems to develop a peculiar poison, which has occasionally caused very serious illness; and another source of danger is the yellow coloring matter employed in tinging the outside of the cheese, or the cloths in which it is wrapped. Arsenic in considerable quantity has, it is said, been detected under such circumstances.

Toasted cheese, in the form called by some Welsh rarebit, is even more unwholesome than cheese before it is cooked, and should never be indulged in, except by those with unusually strong stomachs and good digestions.

In America, the most common adulteration of cheese consists apparently in the mixture of lard with the milk in place of the butter, which is removed during the process of manufacture. In this way the dairyman manages to draw a double profit from his milk, by producing in this lard-cheese a deteriorated article of diet. Whilst this is a fraud which interferes greatly with the business of the honest dealer in whole-milk cheese, there is no evidence that this sophisticated product is injurious to health.

### Nourishing Properties of Eggs.

Eggs furnish one of the most precious resources for the nourishment of human beings, and in all civilized countries contribute largely towards supplying the nitrogenous ingredients of diet. Like milk, the egg is an almost complete food, containing in itself three of the four great classes, and furnishing largely both albuminoid matters, fats, and saline materials. Eggs are more easy to digest than most kinds of meat, because the organized muscular fibres of the latter are with more difficulty separated by the action of the juices of the stomach. Much depends, however, upon the mode of culinary preparation to which eggs are subjected. If, for instance, an egg is simply beaten up with sugar and water, or if it is soft boiled, as it is called, so that the white is only slightly solidified, digestion may take place very rapidly. When cooked in the form of an omelet, or boiled so that the white and yolk are both rendered quite hard, the digestibility is correspondingly diminished; and fried eggs, especially if associated with any fatty substances in the process of frying, are found to be difficult of digestion, and extremely unwholesome to many persons. When eaten at all hard-boiled or fried, eggs should be very thoroughly masticated, as experiments upon the artificial digestion of the white of hard-boiled eggs have proved that the state of mechanical division has an important influence in modifying the rapidity with which solution by the gastric juice is effected. The yolk of the egg alone is equally nutritious, and more digestible than the white in a thoroughly cooked state, and when beaten up with sugar and water the yolk forms a light, pleasant, and highly nourishing liquid, called by French authors chicken-milk, and largely employed in low conditions of the system with feeble digestion. When an egg is not perfectly fresh, its weight is generally diminished, by the evaporation of its fluid portions through the shell, and a corresponding enlargement of the bubble of air which occupies one end. This change affords a ready means of detecting stale eggs, by putting them into a solution of common table salt, 1.6 ounces to the pint, into which a perfectly fresh egg will slowly sink. As a general rule, eggs three or four days old can thus be readily detected; or the enlargement of the bubble of air can be discovered by the diminished opacity at that end of the egg when examined by looking through it at a bright light. Eggs change rapidly by keeping, becoming not only less acceptable, but also less digestible to the stomach. In a very few days they begin to give off a peculiar odor, in which the foul-smelling gas, sulphuretted hydrogen, is prominent. It is this gas which so quickly blackens silver spoons or forks which come in contact with eggs that are not perfectly fresh.



### **The Hygienic Relations of Vegetable Foods.**

We come now to a consideration of articles of diet derived from the vegetable kingdom, which are so numerous that only the more important can be discussed in detail. The sustenance of all animals is derived from the vegetable world, either directly, as in the creatures purely herbivorous, or indirectly, in the carnivorous animals, which prey upon the plant-eating species of animated nature. When man nourishes himself upon flesh, he finds in it already prepared many of the proximate principles most valuable to his organism, which the ox or the sheep has previously borrowed from the herbs of the field. When, however, he feeds upon vegetables, he no longer profits by the labors of these living creatures, which have already raised their tissues a long step beyond the first or vegetable stage of progress upward from the level of the inorganic elements of nature. In seeking his alimentation from plants, therefore, he commences in himself the series of transformations by which matter is elevated from an utterly inanimate state to the highest condition of organization.

Chief among the vegetable foods must, of course, be ranked the cereal grains, which, in general features, resemble each other, all containing starch, gluten, sugar, gum, woody matter, and mineral salts. Since the gluten is a nitrogenous substance, wheat and the other cereals are able, as is well known, for a time to sustain life without meat.

Pre-eminent among the cereals stands wheat, well denominated the "staff of life," because in it are found starch, sugar, gluten, and phosphate of lime, in such quantities and available forms that man can probably subsist on it longer and with less derangement of his system than upon any other single article of food. In grinding wheat into flour it is usual to separate the bran, but in doing this a certain proportion of the gluten, and probably most of the mineral salts, are removed and, of course, lost to the system. Some writers upon this subject contend that many of the diseases of civilized life are produced directly or indirectly by depriving our systems of the materials existing in the outer coat of the wheat grain, and intended by nature to contribute important constituents to the animal economy. It might, however, as well be argued that it is the duty of mankind to eat beef with the hide, hoofs, and hair all upon it, because that is the way nature furnishes it in the living state.

### **Value of Bran-Bread in Constipation.**

During the processes of grinding, bolting, and so forth, a separation is effected into about eighty per cent. of flour and sixteen per cent. of bran, nearly four per cent. of the weight being lost in the operation. If the bran is not completely removed, bread made from the flour is apt to act upon the bowels of those unaccustomed to it, and may keep up intract-

able diarrhœa and dysentery for a long time if its influence is unsuspected. On the other hand, obstinate constipation can frequently be overcome by the constant employment of bran-bread, or of bread made from the entire wheat-grain. Again, bread prepared from the finely pulverized bran alone is very important in the treatment of diabetes, as will be pointed out when describing the management of that intractable disease.

Good flour should be white, or with only the faintest tinge of yellow, neither lumpy nor gritty to the touch, without acidity to the taste, and free from odor of fermentation or mouldiness. A simple method for detecting any considerable adulteration with mineral matter, such, for example, as the "flour grade" of powdered white stone, furnished by the New England mills already alluded to, is the following: Put into a two-ounce bottle a tea-spoonful of the suspected flour and two tea-spoonfuls of chloroform; shake the mixture strongly, and let stand for a quarter of an hour. At the end of that time, the flour will be found floating upon the surface of the fluid, whilst any foreign mineral sophistications will settle to the bottom. In many instances, the best test of the value possessed by a specimen of flour is the practical one of making and baking a loaf of bread with it. In this way adulteration of the flour with some of the cheaper cereals, or with flour which has become mouldy, and with the flour of beans and peas, may often be discovered. But in some cases it may be necessary to make a microscopical examination of the sample, which will generally solve the problem of sophistication.

The manufacture of bread is carried on in three different modes, which, however, need only be described here in their hygienic relations. The first, and far the oldest, method is that by the aid of yeast or leaven, which is made up of a curious little microscopic plant called the *Torula Cerevisia*, which grows with great rapidity, under favorable circumstances, through the dough, and produces in its development bubbles of carbonic acid gas. These bubbles of gas, rising through the mass of dough, lift it up and puff it out, causing the porosity which makes good bread so light, palatable, and relatively easy of digestion. If the heat to which a rising loaf of bread is exposed becomes too great, or the process is allowed to go on too long before it is stopped by baking the loaf, and so immediately killing the fungus as soon as it has accomplished its good work, another kind of fermentation is set up, which results in the production of acetic acid or vinegar instead of the gaseous carbonic acid, and the loaf is rendered heavy and sour. This is the great danger of bread made with yeast, because a sour loaf is very apt to prove highly indigestible, and may even bring on vomiting and diarrhœa, these being the two emphatic reproofs nature administers to us when we violate her laws by putting unwholesome food into the stomach.

In the second method of making bread, carbonic acid is again the agent for causing the bread dough to rise up, and for rendering the resulting

bread light and spongy. In order to save time, and also the trouble of keeping up a supply of yeast, the carbonic acid is set free from some kind of baking powder, which is generally composed of carbonate of soda or ammonia and an acid, such as tartaric, phosphoric, or muriatic acid. The disadvantage of this plan, from a hygienic point of view, lies chiefly in the fact that most of the baking powders, vended in the markets of the United States, at least, contain alum and other mineral ingredients, which are apt to prove prejudicial to health.

The third mode of manufacturing bread is to force carbonic acid into dough under a heavy pressure, mixing it thoroughly by machinery, and then baking it in the usual way. The advantages of this plan are the superior cleanliness, purity, and equality of the product, the absence of all unwholesome mineral ingredients, and the avoidance of all danger of acid fermentation, since only an hour elapses from the time of opening a barrel of flour until the bread is ready to be delivered to the customer. Its disadvantage is that it has a peculiar taste, about which, according to the old adage, there is no use of disputing. This flavor, whilst agreeable to some people, is to others by no means so pleasant as the flavor possessed by a fresh baker's loaf.

Although, as already mentioned, bread is very valuable as an article of diet, it contains too small a proportion of nitrogen, and is too miserably poor in fat, for us to live upon it alone. The process of baking renders bread far more digestible than dough, as we often see exemplified in persons who are compelled to partake of doughy bread, which has been insufficiently cooked. When well made, people do not readily become tired of its constant use, perhaps because of the great variety of its chemical constituents.

#### **Diseases from Inferior Flour and Bread.**

Among the diseases connected with the quality of flour and bread should be considered, first, those which arise from the flour being originally bad, either in consequence of its containing ergot or other impurity, or as a result of its being in a state of fermentation, due to the development of fungous growths. Fermenting flour is apt to produce dyspepsia and diarrhoea, the process of fermentation being doubtless excited to much greater activity by the warmth and moisture of the stomach, and perhaps reacting again, when thus promoted, in producing such a high temperature as to cause all the sensations of intense burning pain in the digestive organs of which dyspeptics so frequently complain. The heat thus given out by the fermenting mass originates in the same way, and may, perhaps, in rare instances, attain almost the same elevation as that found in a hot-bed arranged for forcing vegetables.

The most serious disease resulting from bad flour is ergotism, which is defined to be a train of morbid symptoms produced by the slow and



accumulated action of a specific poison, occurring in a fungus peculiar to wheat and rye. In severe cases this poison gives rise to convulsions, mortification of the hands and feet, and death. This malady is much more common from eating rye mingled with unsound grains affected with the fungus of ergot or cockspur, called also spurred rye, but the same effect has been observed as a result of eating ergotized wheat. The gangrenous form of ergotism, which is the most dangerous variety, is ushered in by excessive weakness, more or less protracted and accompanied with fever, the hands and feet become painful, cold, and rigid, afterwards benumbed and almost insensible. Severe internal pains prevail in the limbs, and this symptom, which has received the name of *Acrodynia*, is greatly aggravated by heat. It extends by degrees from the toes to the legs and thighs, and from the fingers to the arms and shoulders, after which complete mortification soon results. With the exception of slight fever, the general disturbance of the system is, strange to say, insignificant, and herein this curious malady resembles scurvy. An epidemic of ergotism occurred in France many years ago, at a time when, in an unusually unfavorable year, the rye which was used as food by the common people of *Sologne* was one-fourth ergot. In this outbreak the affection generally began in one or both feet, with pain, redness, and the sensation of intense heat, as if they were on fire. At the end of some days these pains ceased as suddenly as they first came on, and the sensation of extreme heat was then exchanged for that of cold; the parts affected are described as becoming black like a piece of charcoal, and as dry as if they had been passed through the fire. A line of separation tended to form between the dead and the living portions, like that which ensues in the separation of a slough produced by the application of a red-hot iron. This form of the disease appears to affect animals as well as man, since the recent alarm in regard to an outbreak of foot-and-mouth disease among the cattle of a Western State, is reported to be an epidemic of ergotism produced by eating diseased grain. The other form of ergotism is the spasmodic, which commences with tingling and itching of the feet, followed by pain about the heart, and similar tingling sensations in the hands and head; violent contractions of both hands and feet follow, and the pain is reported to resemble that of a dislocation. The sensations in the portions of the body involved is also occasionally described as that of severe bruising, and the body is bathed in copious perspirations. The convulsive symptoms sometimes remit for two or three days at a time, but drowsiness, giddiness, indistinctness of vision, and an irregular gait are almost constantly present. Deep stupor and epileptic convulsions are apt to come on, and they generally indicate a fatal result. In milder cases, an inordinate appetite accompanies the train of evils, spots like those of *purpura* appear upon the face, and the disease rarely abates before the end of the third week.

In the second place, we may have disturbance of the health arising from bread made out of flour which was originally good, but which had become altered, either from age or from not having been properly dried. Bread made from such flour is often acid, and sometimes highly so, and this sour condition may cause diarrhœa, but it does not always produce that effect; usually persons will not eat much of it, and thus the health is affected by the supply of nutriment being diminished. If bread is too moist, fungi form upon it rapidly, and an orange-colored mould is reported as giving rise to diarrhœa in those who ate it. According to Dr. Parkes, the common green mould of bread and paste rarely, if ever, produces diarrhœa; but mouldy oats has certainly given rise to paralytic symptoms in horses, and caused many deaths, so that all these fungi must be looked upon with suspicion.

In the third place, bread may be bad from substances added to the dough or to the flour from which it is made. The chief ingredient of this kind is alum, introduced in baking powders, or put in by the baker to whiten the loaf, or to prevent it from souring. The ill-effects of alum in bread have been very much disputed, but there can be little doubt that it does cause dyspepsia in some people, especially those whose stomachs are naturally weak or are debilitated by disease. It also lessens the nutritive value of the bread, probably by combining chemically with some of the phosphoric acid of the wheat to form an insoluble and therefore almost useless compound. Formerly alum was used by bakers in large quantities, the amount of forty grains having been extracted from a single four-pound loaf, but its addition is now forbidden by law in England. The mixture of certain seeds, plants, and so forth, with flour and bread, either by accident or design, has in some instances given rise to injurious results, but such cases are rare, or at least rarely detected in this country.

#### **Lead-Poisoning from Impure Flour.**

Several remarkable cases of metallic poisoning, reported in sanitary periodicals, have been traced to the presence of lead in flour, from which the bread eaten in these instances was made. The lead was found to enter the flour during the process of grinding, in consequence of the dangerous practice resorted to by some millers of repairing their stones with lead. In one instance, related by Dr. Alford, where between fifteen and twenty persons were simultaneously affected, the millstone was discovered to have a very loose texture, and to have its many large cavities filled up by pouring into them quantities of molten lead. It was estimated that there were ten pounds of lead upon the grinding surface of the millstone in this instance. This was, of course, an unusually large quantity, but it is very common to see small holes in a millstone stopped up by the miller with lead, from which enough of this dangerous metal might easily be rubbed off into the flour to affect persons especially sensitive to the action of lead.



The ordinary tests for lead, such as have been already described when speaking of water-analysis, would enable any one to detect the presence of this poison in flour or bread.

### Other Cereals as Food.

The other cereal grains—rye, barley, oats, corn, millet, and rice—are valuable as affording the means of introducing a variety into our diet, so as to avoid the tedious sameness of an incessant round of wheat-bread. The flour of rye gives a bread of a brownish color, heavier and more compact than that of wheat, because the small amount of gluten in the rye does not so well shut in the bubbles of carbonic acid gas formed during the process of fermentation. Partly on this account, it remains fresh longer than wheat-bread, not drying up with the same rapidity. Barley-flour is poor in gluten, and has a peculiar odor, which renders the bread made from it disagreeable to some persons. Oatmeal is much used in Scotland, and employed to a considerable extent, in England and in the United States, in porridge and in cakes. Persons depending on an exclusive diet of oatmeal gain a good deal of fat, but are, it is stated, apt to suffer from dyspepsia and its attendant evils. A moderate quantity of oatmeal, in conjunction with other starchy elements of food, often proves highly useful in overcoming a tendency to habitual constipation, and many people, especially children, may derive great benefit from its employment in this way, in consequence of its laxative effects. Maize or cornmeal is extensively used in America, and also to some extent in Turkey and the eastern parts of the French republic. In Italy it is largely consumed by the lower classes in the form of polenta. Cornmeal is remarkable for containing a large amount of fatty matter, which exists in a proportion nearly four times as great as that found in wheat. It is this abundance of fat which renders corn so valuable for fattening animals for market, and the corn-fed pork of our Western States is widely known and esteemed. Corn is, however, poor in saline ingredients. Rice is probably the most digestible of all the members of its class, and serves as the chief starchy element in the diet of the Chinese and Japanese. It contains, however, relatively small proportions of both the nitrogenized and the fatty constituents, and requires, therefore, to be supplemented to a considerable extent with articles containing these important proximate elements, in order to nourish the human system to the best advantage.

### The Hygienic Value of Peas and Beans.

The leguminous plants, under which title are ranged the various kinds of peas and beans cultivated by man, are broadly distinguished from other vegetable foods, as regards their dietetic properties, by the relatively great amount of nitrogenous matter they contain. In this quality they are strikingly in advance of the cereal grains, supplying sometimes



nearly double the quantity of nitrogen ordinarily found in wheat. The form in which nitrogenous matter is present is legumin, which is the vegetable representative of casein in milk. On account of this ingredient, beans and peas possess a high nutritive value, and furnish a food which is more satisfying to the system than vegetable articles of diet generally prove to be, since they are thus allied more closely to the alimentary products of the animal kingdom. They thereby supply an advantageous article of food during the frequent fasts from meat enjoined in Italy, Austria, Belgium, and other Catholic countries, and with the aid of rice and very little meat, are found sufficient to sustain the lives of vast multitudes of people in the hot climates of Hindostan and China. As a drawback to their high nutritive value, the leguminous seeds must be ranked as difficult of digestion, and except when very immature they require long boiling to render them tender and susceptible of due mastication in the mouth. They are apt, besides lying heavy on the stomach, to occasion flatulence and colic, and the flatus is generally charged with a considerable quantity of sulphuretted hydrogen gas, arising from the sulphur contained in legumin, which renders the discharges unusually fetid. Sulphur is regarded as stimulating or heating to the system, and it is probably on account of this property that a moderate quantity of beans has been found such a serviceable adjunct to the food of the horse during the winter months, a result of practical experience which might be more generally applied to the arrangement of human diet-lists, with beneficial results. Lentils, which are largely used as an article of food upon the continent of Europe, have the same advantages and disadvantages possessed by others of the leguminous products. They are chiefly interesting as forming, when mixed with barley-flour, the prepared food for invalids, sold under the name of *revalentia Arabica*, and, in combination with Indian corn, the compound *ervalenta*.

#### The Potato as an Article of Diet.

Next in importance to the various kinds of seeds, among the vegetable nutriments, must be ranked the potato, which, originally a native of South America, seems now to thrive in all climates, and is cultivated in almost every part of the globe. Until the disastrous failure of the potato crop in Ireland, in consequence of the astonishing spread of that parasitic fungus which causes the potato-rot, the curious *Botrytis infestans*, it constituted nearly four-fifths of the entire food of the inhabitants of that country. Indeed, Dr. Edward Smith declares that it was formerly common for an adult Irishman to consume his three and a half pounds of potatoes at each meal, or more than ten pounds per day. Potatoes consist more largely of water than any of the vegetable foods hitherto considered, the aqueous ingredient making up about three-fourths of their entire weight. Of the remainder, nearly nineteen per cent. is starch, about three

per cent. sugar, two per cent. nitrogenous matter, and less than one per cent. fatty and saline materials. The starch of the potato is used in large quantities to adulterate the various kinds of arrowroot, but the fraud can generally be detected at once by a microscopic examination. In boiling potatoes, the heat employed first coagulates the albuminous juice contained within and between the cells; next, the starch granules absorb the watery part of the juice, swelling up and distending the cells in which they are lodged; the cohesion of the cells thus becomes destroyed, and they then easily separate from each other, so that the whole potato readily breaks down into a loose farinaceous mass. When these changes are complete, the potato is spoken of as being in a mealy condition. If, on the other hand, the liquid during the process of boiling is only partially absorbed, on account of the imperfectly developed state of the tuber, and the cellular elements are not entirely separated, the potato remains more or less firm, and is spoken of as close, waxy, or watery. When in good condition, potatoes constitute a wholesome and agreeable article of food, and one of which the palate does not easily become wearied. The amount of nitrogenous matter they contain is, however, too small to enable them to form a suitable nourishment alone, so that meat, fish, or some other representative of that class must be partaken of in addition. In some parts of England the peasantry subsist chiefly upon potatoes and butter-milk, which, from the casein present, furnishes the requisite nitrogenous material to support the strength, even under severe labor. In its mealy state, the potato is very digestible; but in its watery or waxy condition it is, on the contrary, a highly indigestible article of diet, and should never be partaken of by dyspeptics, or those who are unfortunate enough to possess delicate stomachs. Of course, young or new potatoes, being always comparatively hard and watery, are much less suitable for the food of delicate persons, at least, than those which are fully grown. The value of the potato as the great anti-scorbutic has been already pointed out, and it is probably more efficient, both as a preventive and as a cure of scurvy, when scraped fine and eaten in a raw state.

The immense quantities of Paris green which have been used to prevent the ravages of the potato-bug, have naturally given rise to the dread that some of this mineral poison might be taken up by the plant, and remaining in the tuber, render it dangerous to man and to animals; or being carried down into the earth, contaminate the water-supply. No well-authenticated instances, among the many millions of people who have eaten potatoes thus saved from the insect plague in the United States alone, have been reported, so that such fears may be dismissed as groundless apprehensions. This opinion is fully confirmed by the results arrived at by Prof. Kedzie, who, after an extended series of experiments, concluded: First, that Paris green being a deadly poison should, when used, be handled with extreme care. By inhalation of the dust, by contact of the



material with sores or raw surfaces, and even with a moist and perspiring skin, it may produce dangerous effects. Second, while classed among the insoluble substances, Paris green becomes soluble to a sensible degree, by the action of what may be called the natural agricultural solvents. Of these, carbonic acid and some peculiar influence exerted by the minute roots of plants may be regarded as the most active. Third, compounds of arsenic, like Paris green, pass after a time into an insoluble condition in the soil, and it is probable that hydrated oxide of iron is the most potent factor in producing this state. Enough of this iron compound is no doubt present in all fertile soils to render inert a comparatively large amount of arsenic, and it is probably to this famous antidote for arsenic that we owe our safety when Paris green is applied to the soil. If the arsenical preparation were employed in such quantity that the hydrated oxide of iron present in the soil was not sufficient to speedily change it to the inert condition, we should expect this deleterious agent would injure the health, or destroy the life of the plants. Of course, the limit of safety must vary with the varying composition of the soil, but one observer places this limit at nine hundred pounds of Paris green to the acre, a quantity vastly in excess of any requirements as an insect-poison. Hence, the power of the soil to remove from solution and hold in an insoluble form arsenious acid and the arsenical compounds, will protect even our water-supply from deadly contamination by the poisons, unless they are used greatly in excess of any actual requirements as insect-destroyers.

Fruits, although holding a subordinate rank, are not without a place of some importance in the list of alimentary substances. In general, thoroughly ripe fruits of good quality are wholesome, refreshing, and of easy digestion. Hence grapes, cherries, strawberries, raspberries, peaches, apples, pears, and plums are all, when eaten in moderation, useful articles of food. These same fruits, however, if they are used unripe or green, and in immoderate quantity, may become the causes of derangements, or even actual diseases, of the digestive apparatus, such as cholera morbus, diarrhœa, and dysentery. Unripe fruits are made up of very dense fibres, considerable proportions of malic, acetic, citric, and tartaric acids, with an insoluble vegetable principle called pectose. The same fruit, when fully ripened, loses this density and hardness of its fibres, contains less acid and more sugar, and has its pectose transformed to a considerable extent into soluble pectin.

These different conditions explain the variable effects which are produced by fruits as an article of diet. They enable us to understand how fruits which, whilst immature, were hard to digest, and of little value as nutriment, become nourishing and digestible, when once they have attained their perfection. This influence of complete maturity is exceedingly obvious in the melon, an excellent fruit when it is well ripened and



in good condition, whilst fully capable of bringing on violent attacks of indigestion if eaten under other circumstances.

When unripe fruits are used at all as food, it is a good plan, from a hygienic point of view, to correct their greenness and their acidity, in many cases, by cooking and the addition of sugar. Fruits thus cooked to a jelly or to a marmalade are much easier to digest, and consequently more wholesome. Figs are slightly more laxative than many other fruits, on account of the numerous little seeds which they contain, and which, acting as foreign bodies upon the mucous membrane lining the intestine, irritate it to some extent, and thus augment its movements and its secretion.

Nuts, such as walnuts, chestnuts, filberts, and almonds, are, as a general rule, rather difficult of digestion, but of considerable value as nutriment. They contain from eight to twelve per cent. of nitrogenous matters, and about four per cent. of fat, but the hazard from their indigestible nature far more than counterbalances their advantages from an alimentary point of view, and they should, therefore, be eaten sparingly, or indulged in only by those whose stomachs have proved themselves capable of great gastronomic feats of strength and endurance. It is difficult to urge too strongly that children should be prevented from forming the bad habit of swallowing the stones of cherries, plums, and grapes. Dangerous inflammation of the bowels, with perforation and almost certain death, have often resulted from want of care in this respect. The peril from such small seeds as those of the grape is not, of course, from the possibility of their obstructing the alimentary tube, but because they are liable to get wedged in a narrow blind canal at the side of the intestine, but communicating with it, and there set up a very fatal form of inflammation, which will be described in its appropriate place under the name of typhlitis.

### **The Accessory Articles of Food.**

Under this head can best be considered certain substances which, although of doubtful or low status as aliments, are yet extremely useful, either in making the food more palatable, as promoters of digestion, or as agents for developing nervous or physical force. The principal articles to be considered in this connection are pepper, mustard, vinegar, salt, tea, coffee, and cocoa. Alcohol, in all its various forms, has been ranked by many authors among the accessory foods, but with very doubtful propriety from a physiological, and with great injury to mankind from a moral, point of view.

Condiments are those substances which, as so well expressed by Dr. Hammond, give piquancy or flavor to the food, and also stimulate the action of the salivary glands and stomach, by reason of their irritating qualities; but though they may be used, and rightly, too, for the purpose

of assisting a debilitated stomach, under circumstances of temporary depression of its powers, their continued employment does not fail to increase the very debility they are desired to remedy. Hence, the present relief is frequently obtained only at the expense of future suffering; and since the dose of the condiment must be continually increased, in order to accomplish the wished-for result, as the digestive apparatus grows acclimated, as it were, to the impression of the agent, there comes a time when a limit must be put to this increase, and the stomach, deprived of its usual stimulus, is powerless to accomplish its duty in the animal economy. The use of condiments generally should be discouraged, except during convalescence from acute illness, in conditions of temporary debility of the digestive functions, and in the period of advanced decline in old age. Under these circumstances, if used in moderation, their evil influence is often scarcely appreciable, and is more than counterbalanced by the good effects which follow, in improving the quality of the blood and invigorating the entire organism by supplying it with better digested food. It is by no means difficult to prove that condiments have a powerful influence in augmenting the amount of saliva and of gastric juice secreted. Every one finds it a matter of every-day experience, that any substance capable of powerfully affecting the nerves of taste will cause the mouth to water, as it is called, by increasing the flow of saliva; and the same truth is readily demonstrated in an even more conclusive manner by experiments upon animals. It is a remarkable fact, and one which shows what an intimate sympathetic relation exists between the several functions concerned in a vital process, such as respiration or digestion, that whatever increases the quantity of saliva, also augments the amount of gastric juice poured out by the peptic glands. This can be readily shown by putting any substance possessing a strong taste, such, for example, as vinegar, upon the tongue of a dog in which a gastric fistula or artificial opening into the stomach has been made, on the plan of that produced in the side of Alexis St. Martin, as described on page 152. In a few seconds after the application of the vinegar to the dog's mouth, the gastric fluid will pour forth from the fistulous opening, although no direct stimulation of the gastric mucous membrane can have been produced by the condiment.

Salt, although it has other more important duties in the animal economy than that of a condiment, is so generally used as an agent to render food more appetizing, that it may be appropriately considered here. Haller declares that almost all nations understand the employment of salt; that most animals, or at any rate all the ruminating ones, seek out salt wherever it can be found, and enjoy eating it. In the *Odyssey*, the wise Ulysses is told on one occasion to renew his wanderings, and continue them until he finds a people who have no knowledge of the sea, and who do not season their food with salt. It is said that the Trappist

monks who lived under a vow to eat no meat, but to nourish themselves solely on vegetables and water, took every day a certain quantity of dry salt, which enabled them to support the most painful labors and austerities, and to preserve in some cases robust health to an advanced age. The salt which cattle and sheep find in the saline marshes on the border of the sea seems to render them stronger, make them more healthy, and enables them to fatten more rapidly. In the body of an average-sized man there usually exists nearly half a pound of salts of various kinds, chiefly chloride of sodium, or kitchen salt, and similar compounds. These salines pass off every day in considerable quantities, in the secretions of the skin and of the kidneys, as well as in the discharges from the bowels. They must, therefore, be regularly replaced by new supplies in the food, in order that the alkalinity of the blood may be kept up, the hydrochloric acid of the gastric juice constantly furnished, and the series of operations called the osmotic processes duly carried on.

Pepper, which is the next condiment on the list, is the unripe fruit of the *Piper nigrum*, a plant growing in the East Indies. The odor of the berries is pungent, and the taste hot and acrid. In large doses, pepper affects the general circulation, stimulating the heart to increased action, and rendering the pulse fuller and stronger. Pepper is well established in popular favor as a wholesome stimulant to digestion, and the extent to which it is used has led to its adulteration in a great many instances, but no more injurious substances have been found in sophisticated black pepper than ground flaxseed, ground rice, wheat-flour, and starch. Pepper contains a crystallizable active principle, an acrid resin, and a volatile oil to which its odor is due. Cayenne pepper is the product of *Capsicum annum*, and several other species, which are cultivated in various parts of the world. The fruit, which is a kind of berry of a bright-red color, is the part employed as a condiment. The intensely burning taste of Cayenne pepper renders it an easy subject for adulteration, which is practiced to a very great extent. More care must be exercised in regard to these sophistications of red than of black pepper, because two virulent poisons—the red oxide of lead and the sulphide of mercury—have been detected in the former. Generally, however, a very brief examination under the microscope will suffice to reveal the fraud.

Another condiment which is also very commonly the subject of adulteration is mustard. This substance is the product of two plants, the *Sinapis alba* and the *Sinapis nigra*, which furnish the yellow and the black mustard-seed respectively. The sophistications of yellow mustard are, as far as known, innocent in their character; the series of forty-two samples examined by Dr. Hassall many years since, although they were all adulterated, containing nothing more injurious than wheat-flour and turmeric. The chief danger arising from the employment of such inferior mustard lies in the chance of being led to depend on it as a counter-irri-



tant, or an emetic, in some serious case, where it is important that prompt relief shall be obtained. Care should be taken, therefore, to provide in every household at least a small supply of genuine mustard for medicinal use, after which the weaker the stock on hand for employment as a condiment is, the better for both the pocket of the vender and the stomach of the purchaser.

Vinegar is not only a condiment in the strict sense of the word, but it also aids directly, by its solvent action, to dissolve the fibres of meat and other ingredients of human food. It therefore forms a valuable assistant to the gastric juice in some instances. Genuine vinegar, to which we are all comparative strangers, is a fermented cider or wine, or may be produced, though of not quite so good a quality, by fermenting a solution of malt. It contains acetic acid, with a small amount of gluten, saccharine, and coloring matter. Ordinary vinegar is very frequently adulterated, as already mentioned, with a weak solution of sulphuric acid, the most powerful mineral acid known, which has a tendency to injure the mucous coat of the stomach, destroy the teeth, and bring on diarrhœa and dysentery in the worst or ulcerated form. Fortunately we possess a very delicate test for the presence of sulphuric acid, either alone or combined, in the salts of barium, which give a bulky white precipitate whenever solutions of these two substances are mixed together. In order to apply this test to a sample of vinegar, dissolve half a dram of the barium nitrate in a quarter of a pint of rain-water, and then pour a teaspoonful of this solution into two tablespoonfuls of the suspected vinegar. If it is adulterated with sulphuric acid, you will immediately see a heavy white cloud appear in the liquid, which will soon settle down to the bottom of the vessel in which the little experiment is performed. Sophistication with sulphuric acid may be very strongly suspected if, on looking at a drop of the vinegar with a strong hand magnifying glass, or small microscope, none of the curious little vinegar eels can be discovered; although a sample of vinegar should not be condemned on this evidence by a person who is not acquainted with these remarkable little worms, which wriggle about under the microscope in their tiny drop of fluid almost exactly as full-sized eels do in a pond of water.

#### Hygienic Value of Tea, Coffee, and Cocoa.

We next come to a group of the accessory foods which have been well described as stimulants devoid of intoxicating properties. In each of these three substances, to wit, tea, coffee, and chocolate, there exists a nitrogenized principle, which possesses exhilarating and stimulating properties, and which has apparently determined their selection by man. Their adoption over the whole surface of the earth offers a close parallel to the wide-spread, yet independent, discovery of alcohol by various nations. Schleiden in speaking of them says, thus have all these bever-

ages become everywhere necessities of life; everywhere is the origin of their use enveloped in mythical obscurity; everywhere has man, not led by rational considerations, by knowledge of their properties and action, or by comparison of them with well-known nutritive substances, but, as it were, by instinct, added them to the number of his daily wants. And Baron Liebig, after reviewing the records of the widespread consumption of these substances, and pointing out how they form parts of the daily arrangements in regard to food of the poorest laborers, comes to the conclusion that, when we reflect upon these facts, it is impossible to admit the assertion that the use of tea and coffee is always the result of a mere habit. It is estimated that coffee-beans and leaves are prepared and drunk by sixty millions of the human family; tea of all kinds is used by five hundred millions; opium by four hundred millions, and alcohol in its various forms by five hundred millions of the human race. Tobacco is probably used by seven or eight hundred millions of the people of the world, which, it may be remembered, is believed to contain between thirteen and fourteen hundred millions of inhabitants. These startling facts indicate that a large proportion of the race to-day is using substances that are either stimulants or narcotics. The great work of the physiologist in the future will be to determine the true place in nature, from a hygienic point of view, of these powerful agents, and indicate where their use ends and their abuse begins.

The active vegetable principle of tea, called thein, is, when separated by chemical processes, found to be a decided stimulant, and gives to food a desired something which is not supplied by mere quantity or bulk. There seems to be no doubt that the use of this vegetable principle enables a person to get along with a less amount of food than he would otherwise require. In this connection, it is worthy of note that these vegetable elements of tea and coffee are rich in nitrogen, and are chiefly consumed by nations whose ordinary diet is deficient in that substance. For example, tea is employed largely among the rice-eating Chinese, coffee among the date-eating Arabs, and cacao among the Indian-corn-eaters of Mexico. Although the amount of nitrogen appears too small to be of any great service in itself, this strongly suggests the idea that, during the operation of digestion, some chemical process which we do not as yet understand, in that extraordinary natural laboratory, the alimentary canal, contrives to utilize it to unusual advantage. Be this as it may, however, the fact remains that these vegetable principles are found in use among peoples especially whose food is almost wholly saccharine and starchy in its nature, and that the poor laborer, whose diet-list is particularly defective in nitrogen, attaches the most importance to his tea and coffee, and will set apart no insignificant share of his scanty wages for their purchase. One of the most remarkable properties of these agents is their power of putting away sleep, and thus keeping up a



condition of wakefulness. For this purpose they have long been employed by diligent students, too often, it is to be feared, to the serious injury of both their mental and physical energies. Coffee was first brought into use, it is said, by devotees, who desired to keep themselves awake during the Mahometan nights of prayer, and the legend associated with its origin is to the following effect: A holy man, who spent much time in nocturnal supplications, was much troubled with drowsiness during his vigils, and at last, in his anger, cut off his offending eyelids and threw them on the ground. The coffee-tree sprung up immediately therefrom, and the form of the amputated eyelids is miraculously perpetuated in the leaf of the plant.

The vegetable principles — thein, caffen, and theobromin — are true stimulants, in that they possess the power of enabling a person to defy sleep, and to borrow, as it were, waking and working capacity from his own future ability. In this respect there is no difference between their action and that of alcohol, but they are free from some of the subsequent effects of alcoholic drinks, which contribute to render alcohol so seductive to poor humanity, and so lead on to beastly drunkenness. Intoxication, in the sense of drunkenness, these vegetable principles do not produce, although intoxication, in the sense of well-marked stimulation, they certainly can effect.

The excessive consumption of tea and coffee, particularly with an impoverished diet-list, so far as the other nitrogenous elements are concerned, leads to a condition of nervousness and irritability often quite pitiable. It is also apt to result in dyspepsia, with serious impairment of the digestive organs, and to attacks of neuralgia. Indeed, evil consequences of the excessive use of tea are as marked in certain of the lower classes of social life as are those of alcoholic excess, and the habit of taking two or three cups of tea, instead of more food, or for the purpose of enabling an individual to borrow so much more strength from herself, is among seamstresses and other working-women, in some communities, as common as the use of alcohol for similar objects is among men.

Tea is the dried leaf of a small shrub growing chiefly in China and Japan, but is often adulterated with the foliage of other plants, such as the willow-tree, and with grasses of the various species. The two important varieties of tea in our markets are the black tea and the green tea, which, however, differ from each other chiefly in the time when the leaves are gathered, and their mode of subsequent preparation. After gathering, it is stated that the black teas are plunged for an instant into boiling water, dried, and then torrefied on iron plates, finally aromatized in various ways, and rolled together as we see them. The green teas are, on the other hand, dried by steam-heat in closed iron vessels; subsequently the green teas are colored or faced, as it is called, with indigo or Prussian blue. Both of these additions are harmless, or nearly so, but in some few



instances copper, in some of its various forms, has been detected in green tea, so that it is better not to use green tea when black can be procured. In the same way that the Arabs keep for themselves the best sorts of coffee, the gatherings of Mocha, which are most highly perfumed, the Chinese cultivate, gather, prepare, and preserve for themselves the finest and most aromatic kinds of tea. The true Imperial tea, destined for the Court of Peking, is said to be entirely unknown to Europeans. In composition, tea presents considerable resemblance to coffee, independent of its active principle. It contains a large proportion, from twenty to thirty per cent., of nitrogenous matter, a highly volatile and aromatic essential oil, and thein, which is only freely soluble in hot water, and is combined with tannic acid, of which green teas possess about eighteen, and black teas about thirteen, per cent. The infusion of tea, as usually brought to the table, is made of about the average strength of half an ounce to the pint of boiling water, which should be allowed to stand upon the leaves to draw, as it is called, for not more than ten minutes. In this way about thirty per cent. of its weight is extracted from green tea, and about twenty-three per cent. from black tea. It is important that the infusion should not be allowed to stand longer than the time mentioned above, otherwise the essential oil is driven off, the delicate aroma is lost, and the liquid acquires a bitter taste and an astringent flavor, which it owes to the solution of too great an amount of tannic acid. In order to avoid this excess of tannin, the tea should never be boiled, or made by passing the water through the same leaves twice.

Tea, as has been remarked above, is very often adulterated, but the genuine leaf is perfectly characteristic, and when once it is thoroughly known, no difficulty exists in detecting the sophistications. The tea-leaf is in width about one-third of its length, the margins are serrated, and in the large leaves the serrations are well marked. Another point, which is often useful in recognizing the tea-leaf, is that most of the veins proceeding from the mid-rib form a series of loops as they approach the margin. By soaking the tea-leaves in water for a day or two, they can be easily spread out on glass or white paper and satisfactorily examined. Tea-leaves which have been used once are often dried and again offered for sale; and, unfortunately, this ingenious fraud can only be detected by the weakness of the infusion such exhausted leaves furnish, or by chemical analysis. The following considerations in regard to tea are suggested by Prof. Riand: Tea taken after a meal produces a double effect; in the first place, the warm fluid increases the heat of the body and quickens the circulation. Occasionally, in very susceptible individuals, this influence is so marked as to result in a transient febrile movement ending in perspiration. Secondly, tea produces a general excitement of all the functions, and in particular of the digestive apparatus. It is therefore especially useful after eating large amounts of food, and after smaller quantities of

heavy articles of diet, in those whose digestion is slow and difficult, either through natural torpor of the stomach, or that artificial inactivity which results from a sedentary life. It sometimes happens that the tannin obtained from tea interferes with digestion, by precipitating the albuminous substances, already described, in the stomach. Many people find milk harder to digest when mixed with tea than when imbibed alone. The peculiar action of thein, like that of caffeine, is upon the nervous system. Hence the abuse of tea, especially that made from the green tea-leaf, over-excites the cerebro-spinal axis, causing sleeplessness and unnatural irritability of temper, and a predisposition to neuralgic affections. Tea is therefore not suited, as a rule, to nervous temperaments, and to young persons, especially children.

### Coffee in its Hygienic Aspects.

Coffee is the fruit of the *Coffea Arabica*, a shrub or small tree originally from Arabia, but transported thence to India, Europe, and South America. Coffee was used in the East at least as early as the ninth century, but its employment did not become general on the continent of Europe until about two hundred years ago. In Paris it gives its name to the numerous establishments or cafés where it is sold, but in many of these restaurants, unfortunately, more wine and beer than coffee are consumed. In chemical composition, coffee closely resembles tea, containing about fifteen per cent. of nitrogenous matters, including the active principle caffeine; about twelve per cent. of fatty matters, and from six to seven per cent. of mineral substances. The best coffee, called in the East, Mocha, has small rounded grains of a yellow color, and covered with a thin golden skin. After being properly roasted, the berries are ground, and an infusion made of the strength of from one to two ounces to the pint of hot, but not boiling, water. Coffee should never be boiled, as the aromatic principle is altered by a high temperature, and a disagreeable bitterness is imparted to the liquid. Coffee, however, yields only part of its strength to hot water, and, when manufactured on a large scale, it is advised to boil the grounds, and add this decoction to the infusion, which possesses all the unchanged aromatic principle. The adulterations of coffee are very numerous, the most important articles employed for this purpose being chicory, wheat, corn, beans, potatoes, and sugar. Chicory is itself frequently adulterated with roasted barley and wheat, acorns, mangold wurtzel, saw-dust, beans, and peas. All these adulterations can easily be avoided by purchasing the coffee in its whole state, as the berries are so characteristic in appearance that few people could be misled by any sophistication. It is stated, however, that clay has been moulded by machinery into the form of coffee-berries, and sold in large quantities mixed in considerable amounts with the genuine fruit of the coffee-tree. It is in the ground state then that frauds are chiefly practiced, and it is probable that few specimens of ground



coffee can be purchased pure, unless it is ground before the eyes of the customer, as is the usage in many places. The adulteration with chiccory may be discovered by the smell, which differs from that of true coffee, by its yielding a darker and denser infusion, and by the chiccory sinking at once in water when roasted, whilst coffee floats for a long time, in consequence of the development of gas during its exposure to heat, and on account of the non-absorbent nature of the skin of the berry. Chiccory, corn and beans, and starch, could be at once detected by microscopic examination, and the fraud thus exposed.

When taken into the stomach, coffee stimulates the nervous system, and in large doses produces tremors. Its active principle, when given to animals in considerable quantities, excites what are called the reflex or secondary nervous actions, and may produce a peculiar stiffness of the muscles resembling lockjaw. It increases the frequency of the pulse in men, and removes the sensation of commencing fatigue during exercise, if the fatigue is not too intense. It also increases the action of the skin, the lungs, and the kidneys. Coffee has proved itself an important article of diet for soldiers, sailors, and other persons exposed to severe labor under adverse circumstances of any kind. It is not only invigorating without producing subsequent collapse, but the hot infusion is almost equally serviceable in aiding men to endure heat and cold. In the one case the warmth of the infusion, in the other the action on the skin promoting perspiration, which, as it evaporates, carries off some of the heat, being useful, whilst in both instances the nervous stimulation is very desirable. Dr. Hooker states that, in the Antarctic expedition, the men all preferred coffee to spirits as an agent to help them in resisting the intense cold. And the same is reported of the troops in the Schleswig-Holstein war of 1849.

The hygienic rules in regard to coffee given by Prof. Riant are especially worthy of attention, because the amount of "café noir," or black coffee, consumed by the French people, is something awful to contemplate, and surely great enough to furnish a remarkably good basis for Riant's conclusions. He states that all the effects of coffee vary with habit, temperament, and individual disposition. People of weak constitution and lymphatic temperament find in coffee a stimulant, which antagonizes the languor of the vital actions, digestion is improved, headache is relieved, the sensation of fullness so apt to manifest itself after even moderate meals disappears, muscular and mental energy are both augmented, and the thoughts and ideas tend to assume a less sombre cast. Thin, nervous, irritable individuals should, on the other hand, partake of coffee in great moderation. For such persons it is often a slow poison, giving rise, if frequently indulged in, to palpitation of the heart, loss of appetite, trembling of the limbs, and even painful diseases, such as neuralgia. Coffee should never be given to children, except as a medicine and by the direct



advice of a physician. It should be avoided by young persons, because during youth the nervous apparatus is particularly impressionable, and the important work demanded of every system of the organism during growth should on no account be interfered with.

### Cocoa and Chocolate.

Cocoa, which is obtained from the *Theobroma cacao*, or chocolate-tree, is a Mexican beverage, and is said to have been in use when Cortez first invaded the Aztec Empire. Theobromin, its active principle, is closely allied to, if not identical, with the similar elements of tea and coffee, and is probably a mere variety of them. Its use is greatly upon the increase in this country as well as abroad, and it is estimated that as much as one hundred millions of pounds of it are annually consumed, doubtless with immense advantage to health, if in no other way, as a substitute for more dangerous beverages. The quantity of fat in chocolate is very large, that in some kinds of cocoa ranging as high as forty-nine per cent., the nitrogenous constituents average nearly fifteen per cent., and the active principle, theobromin, one and a half per cent. The ash contains a large proportion of phosphate of potash, and hence cocoa may justly be ranked as a valuable nerve food. The large quantity of fat and proteid matter makes chocolate a very nourishing article of diet, and, being highly acceptable to most people's stomachs, it is especially suitable to weak states of the system, and is also useful for healthy men who are compelled to make great exertions. In South America, Indian-corn cakes with cocoa are much used by travellers, according to Humboldt, and the large amount of agreeable nourishment in small bulk which such a bill of fare furnishes, enables several days' supply of food to be easily carried. Cocoa is adulterated with wheat-flour, starch, sugar, brick-dust, and oxide of iron, sometimes to a very great extent. Prof. Parkes says that some of the homœopathic cocoas are rightly named, as the amount of cocoa in them is very small.

Maté is the product of the Brazilian holly, and is drunk by the South Americans with the same passion which John Chinaman displays for his tea, and with somewhat similar effects upon the system.

### The Use and Abuse of Alcohol.

The controversy respecting alcohol, which is classed by some writers as an accessory food, is one of such vast extent and importance, from an economical, social, and of late even from a political point of view, that it would be folly to try to decide it positively. But the readers of this book may fairly expect to find set forth some of the prominent facts on both sides of the question, and the author's individual opinion in regard to them.

A peculiar problem, says Schleiden, is indeed presented to the psychol-

ogist, in the remarkable circumstance that, wherever the human race is found, in the highest condition of civilization as well as in the first dawnings of culture, with the exception, perhaps, of some few races more like animals than ourselves, men have the custom of transporting themselves by various means into a higher condition of mental activity, which, in its excessive and evil phenomena, is called drunkenness. The very names of the wonderful variety of alcoholic liquors used in different parts of the world are conclusive upon the point, and the mere existence in common use of the *samsboy* and *saki* distilled from rice, in China and Japan respectively, are terribly significant of the world-wide craving for intoxication, which has been implanted in mankind.

The evil effects of the abuse of alcohol upon the human system, and in particular upon the stomach, liver, and kidneys, are indisputable, and it is equally certain that they differ only in degree, and not in kind, with the form of alcoholic drink which is employed for the purpose of stimulation, whether this liquid be hard cider, which is one of the most dilute, or rum, which is a highly concentrated variety of alcoholic beverage. By observations through the wonderfully convenient window in St. Martin's stomach, already spoken of, it was found that swallowing a glass of brandy had the same irritating influence upon the lining mucous membrane of that organ, which it would have upon the lips or the eyes if applied to them; that is to say, it made the inner coat of the stomach redder and fuller of blood; in other words, produced a temporary congestion wherever it touched. If St. Martin was allowed to drink brandy several times daily, for several days, Dr. Beaumont found that this congestion was kept up and increased, until spots of actual inflammation appeared, and these sometimes ran on to the formation of ulcers or sores upon the mucous membrane. This irritation caused a change in the gastric juice, which was rendered impure and inefficient by the admixture of an unnatural quantity of mucus. Whilst this state of affairs existed, St. Martin himself felt a tenderness and an uneasy sensation at the pit of his stomach, a loss of appetite, and other dyspeptic symptoms, such as most occasional drinkers suffer from when their digestion is disturbed by indulgence in alcoholic liquids. On some persons alcohol acts as an emetic, causing them to vomit freely, but after a time, if they persevere in the practice of drinking, they may learn to keep down the dose, which then has its usual inflaming effect on the gastric mucous membrane, and may lead to the ultimate destruction of the power to secrete gastric juice possessed by that inner coat of the stomach. Nor does the stomach stand alone in being seriously damaged by alcohol, for cirrhosis of the liver, or drunkard's liver, contraction of the kidneys, or one form Bright's disease, and delirium tremens, or the delirium of drunkards, often ending in softening of the brain, are common roads to agonizing suffering and death among those who poison their systems with alcohol.

Neither are the social and moral evils which affect the body-politic, from the abuse of alcoholic drinks of all the various kinds, any less disputable and grievous than those which intemperance brings upon the individual organism. Advocates of the temperance movement assert that statistics show ten per cent. of the annual number of deaths in this country to be due to alcohol; that thirty-five per cent. of the insane in the United States are so directly or indirectly from its use; and that from seventy-five to ninety per cent. of the inmates of our prisons and almshouses owe their debased condition to its influence. Moreover, it is demonstrated that forty-five per cent. of the inmates of our asylums for idiots are the offspring of parents addicted to drink. Although such statements indicate not only that the *abuse* of alcohol is one of the most terrible curses that have ever afflicted humanity, but also that a tendency to this abuse is almost invincible among the poorer classes, if the opportunity is given them to practice it, these and other similar arguments by no means settle the question, Whether there is a proper and beneficial use for alcohol in the animal economy? and if so, whether we can discover and keep within the limit of its safe employment? Among those who recommend both by precept and example the moderate employment of alcoholic drinks, Sir James Paget, the distinguished London physician, is justly eminent, and in writing not long since on the contrast between temperance and abstinence, he says that his study of the question makes him as sure as he could ever venture to be upon any such question, that there is no evidence sufficient to make it probable that a moderate habitual use of alcoholic drinks is generally or even to many persons injurious; and that there are sufficient reasons for believing that such an habitual use is on the whole beneficial. It may be assumed, he thinks, that further study of the matter by competent and calm-minded scientific persons, will discover many facts concerning the use of alcohol which will lead to the remedy of such harm as even in moderation it may do to some persons, or to some whole races of men, and to its use being better directed and limited than in our present customs. Many, admitting this, would contend that moderation ought not to be defended, because its promotion hinders the general adoption of total abstinence, which they say is the only sure remedy for intemperance. Here continues Dr. Paget: "I can only doubt, I should think, that in this, as in other things lawful, yet tempting to excess, the discipline of moderation is better than the discipline of abstinence. But it is certain that we have no facts at all by which to estimate whether the whole benefits of moderation or the whole possible benefits or evils of total abstinence, or the whole sure evils of intemperance, would be the greater; we have nothing from which we may make even a fair guess, or which would justify a great experiment. Without such knowledge, it seems unreasonable to urge the discontinuance of a custom which is certainly pleasant and probably useful, and



very unreasonable to require temperate persons, who are an immense majority of the population, to cease to do that which is lawful and agreeable, in order that the intemperate minority may be induced to leave off doing that which is unlawful and mischievous. It would be no less unreasonable to urge that honest men should cease to gain money because there are some misers, thieves, and swindlers in the community."

The celebrated Baron Liebig declares that, as a restorative, as a means of refreshment when the powers of life are exhausted, as an agent for giving animation and energy when man has to struggle with days of sorrow and trouble, as a means of correction and compensation when misproportion occurs in nutrition and the organism is deranged in its operations, and as a means of protection against transient organic disturbances, wine is surpassed by no product of nature or of art. The nobler wines of the Rhine, and those of Bordeaux, are distinguished above all others by producing a minimum of injurious after-effect. The quantity of wine consumed on the banks of the river Rhine, by persons of all ages, without perceptible injury to their mental and bodily health, is hardly credible. Gout and calculous disorders are nowhere more rare than in the valley of the Rhine, between Maintz and Coblenz, so highly favored by nature. In no part of Germany do the apothecaries' establishments bring so low a price as in the rich cities of this district, for there wine is the universal medicine for the healthy as well as the sick—it being considered as "milk for the aged."

Endeavoring now calmly and dispassionately to make all due allowance for the distortion of partisan zeal, and the unconscious exaggeration with which the opponents upon this momentous question present both their arguments and facts, it seems obvious, and indeed nearly all the advocates of total abstinence, of temperance, and of moderate drinking must agree, that *excessive* use of intoxicating liquors is rapidly ruinous to health, morality, and estate, and generally fatal to life.

In regard to the moderate use of alcohol, the author's individual opinion, founded upon extended observation and study, is that alcohol is not a food, does not when imbibed by healthy individuals permanently increase the strength and endurance, and is not capable of efficiently aiding man to resist heat or cold. It has an irritating, and therefore poisonous, effect upon the stomach, liver, and kidneys; and this effect, if added to day after day by repeated doses of the irritant, results in structural changes in these organs which often cause the death of the individual in whom they occur. Candid seekers after the exact truth in nature must probably further admit that, first, alcohol is not necessary to healthy human beings, either in large or small amounts; second, that its employment in large quantities is the cause of much, perhaps of the major part, of the destitution, misery, disease, and crime which curse civilized communities; and third, that indulgence in occasional stimulation is exceed-

ingly apt to grow into the practice of moderate drinking, and this practice to develop, in its turn, into the habit of immoderate use of alcohol, with all its dangerous and frequently fatal consequences; hence, that it would be better for mankind to abstain entirely from alcohol as a beverage, since its total injury to humanity apparently far exceeds its total benefit. As a check upon its use among readers who are willing to be influenced, a former advice may be here reiterated: "To those who will, and still can, take counsel, I would say, never swallow a drop of alcohol, in any form, except upon the written prescription of a reputable physician."

Many good people whose opinions are worthy of profound respect will, perchance, be inclined to doubt whether such a view of this great question is the correct one, and this largely on the ground that we find in the New Testament, where St. Paul writes to his beloved Timothy, "Use a little wine for thy stomach's sake, and thine often infirmities." In answer to this objection, it may be urged that certain learned biblical historians assert that the wine intended here was the unfermented juice of the grape, containing no alcohol. Even if this be disputed, it may be answered that, in certain diseased conditions of the system, alcohol, like other poisons, such as arsenic and strychnia, may occasionally disturb the intricate machinery of human bodies in such a way, that temporarily the good it does more than counterbalances the harm; and such was no doubt the condition of Timothy when Paul directed him to resort to wine as a medicine. But alcohol employed in this way is like a sharp-edged tool, such as a razor for example, which if skilfully handled does good work, yet if pushed a hair's-breadth too far gives a wound, and if carelessly used may cause instant death, so that it needs occasionally the wisdom of serpents before even physicians can order wine and yet be harmless with it as doves. Hence it is right to ask of moderate drinkers, who seek to excuse their practice by quoting this passage, that they follow their own text, and wait, as it appears Timothy did, for an inspired apostle to order wine, and that even then they take *only* "a little."

The conditions which would justify from a medical point of view the employment of alcohol in the form of beer, wine, or brandy, may be stated as follows: First, during the progress of or in the convalescence from acute or chronic illness; second, under circumstances of extraordinary, but very temporary and infrequently recurring, mental or physical over-exertion; and third, in the advanced period of decline in the human organism, when marked failure of the digestive powers comes on. This liberty ought never to be permitted to those who cannot be trusted, that is, to those who, the medical adviser knows, or has reason even to suppose, from his knowledge of their hereditary tendencies or otherwise, do not possess the moral strength to withstand the temptation of letting it degenerate into license. Physicians cannot be too careful, in prescribing stimulants of every kind, *not* to encourage any man, woman, or child in the debasing vice of drunkenness.



### Varieties of Alcoholic Liquors.

Alcohol is never found in nature, but is artificially produced by the process of fermentation in the juices of certain fruits and in some vegetable infusions. Hard cider, beer, ale, wine, brandy, whisky, gin, and rum all contain alcohol, though in very varying proportions, and in all these liquors it is the alcohol which chiefly affects the system, when swallowed into the human stomach.

Cider is the juice of apples which have been ground up and then squeezed in a powerful press. When first made it is called sweet cider, and is devoid of any intoxicating quality; but if allowed to stand in a warm place, fermentation soon begins, and in the course of a few weeks, a portion of the sugar derived from the fruit being converted into alcohol, the liquid becomes hard, as it is called, the sweet pleasant flavor of the apple-juice being entirely lost. Hard cider, then, is a very dilute alcoholic liquid, containing about three parts in the hundred of alcohol, and is therefore a weak intoxicating drink, capable in time, if taken in sufficient quantities, of producing all the evil effects of stronger liquors, such as whisky, upon the human body.

Beer is a fermented infusion of barley made into malt, which is the barley-grain after it has started to grow for a few days, with the addition of hops. The reason the barley is warmed and moistened until it sprouts is that, in this condition, a greater quantity of sugar is developed in the grain, and hence a larger amount of alcohol is formed in the beer when it is brewed. The amount of alcohol in beer, and also in ale and porter, which are similar to it in nature and origin, varies from two to ten per cent. On account of these beverages containing some of the bitter principle of the hops, they are especially valuable in convalescence from illness, when it is advisable to combine the advantages of a mild tonic and a gentle stimulant both to the general system and to the enfeebled digestive powers.

Wine is the fermented juice of the grape, and appears to have been known over four thousand years ago, when our common ancestor, Noah, so far forgot his merciful deliverance from the flood as to become drunk with wine. In France, Spain, Germany, and Italy, almost incredible quantities of wine are made from grapes grown for the express purpose, although very little of what is sold in America under that name comes across the ocean—the great bulk of what passes here for wine being a fraudulent mixture of water, coloring matter, whisky, and flavoring substances. Champagne and claret wine contain from five to thirteen parts in the hundred of alcohol, whilst port and sherry have from fifteen to twenty-five per cent., the latter being, therefore, sometimes one-fourth pure alcohol. Wines vary somewhat in their effects upon the human system, on account of the different ethers and other ingredients they



contain in addition to the spirit; but their main influence upon mankind is identically the same, and solely due to alcohol, which, in spite of all assertions to the contrary, is the chief active agent in them, as in all other fermented and distilled liquors. Champagne, on account of the carbonic acid gas which the sparkling varieties hold dissolved, is frequently the most acceptable wine to a sick stomach, and there are times when, for days, the only thing which can be borne in the way of either nourishment or stimulant is iced champagne, given in small doses, repeated at short intervals. Claret wine is often the most suitable to prescribe for taking with the food, in states of feeble or torpid digestion, especially in warm weather; and port wine is particularly to be recommended where there is a tendency to diarrhœa and dysentery, and to be forbidden in the opposite condition of constipation, because it has in its composition a larger proportion of tannic acid than any of the other varieties. In fact, so largely are most of the cheaper port wines adulterated with logwood in this country, that a real, thoroughly adulterated port very often makes a good diarrhœa mixture without the addition of any other ingredient.

Whisky is the distilled spirit obtained from a fermented infusion of corn or rye. The chemical process of distillation is founded on the fact that alcohol boils at a lower temperature than water does, so that, if a mixture of alcohol and water is carefully heated up to the boiling-point of the former fluid, and no hotter, there is given off a vapor composed of a great deal of the spirituous and very little of the aqueous element. By suitable apparatus, consisting of a long tube coiled up in a spiral form, and hence called the worm of the still, which is kept cold by being immersed in a tub or vat filled with cool water, the alcoholic vapor may be condensed again into a fluid, which constitutes, when prepared in the manner just described, the rye- or corn-whisky which does so much harm in the world. Brandy, when genuine, is distilled from wine, but as sold in the United States is generally a fraud, being only colored and flavored whisky. It is of about the same spirituous strength as whisky, containing from fifty to sixty per cent. of alcohol. Brandy and whisky are the stimulants usually resorted to in conditions of great debility, as, for instance, in typhoid and typhus fevers, or in pneumonia, when the powers of life are at a low ebb, and it is a question of life or death whether the heart can be kept beating and lungs pumping in air for a few days or even a few hours longer, until the force of the disease is spent and the remedial powers of nature have time to collect themselves for a new struggle. Under such circumstances, most unprejudiced practitioners of medicine have seen wonderful recoveries take place—apparently as direct results of the stimulant. In cases of this kind, it is wonderful what immense quantities of brandy—sometimes as much as a pint and a half or two pints in twenty-four hours—can be administered,

not only without producing intoxication, but with apparently none but beneficial results. In poisoning by the bites of rattlesnakes and other venomous serpents, brandy or whisky, given as freely as possible, to complete intoxication if that condition can be produced, is the most effectual remedy which has yet been discovered. It probably acts, in this instance, by mixing with the blood in sufficient quantity to prevent the virus of the snake-poison from developing to its greatest virulence and deadliest power.

Gin is a strong distilled liquor, flavored with juniper-berries; and rum, the most powerful of all in ordinary use, is distilled from fermented molasses. Its deadliest effects are in exact proportion to the superabundance of alcohol it contains, which sometimes, in "extra pure old Jamaica rum," amounts to seventy-five per cent., or three-fourths of its entire bulk.

The cordials—Maraschino, Chartreuse, Benedictine, and so forth—are seldom used, and have no particular medicinal value. They are strongly alcoholic and intoxicating. Absinthe, a fashionable Parisian drink, occasionally seen in this country, is a greenish, bitter liquid, distilled from the tops and leaves of wormwood. It is a powerful poison to the nervous system, proving more rapidly fatal to those who form the habit of taking it than alcohol in any other guise.

All these liquors—from hard cider, which is the most dilute, to rum, which is the most concentrated—have exactly the same disorganizing effects upon the stomach, the liver, the brain, and other organs of the human body, although these results differ in degree and in the rapidity with which they are produced, according to the alcoholic strength of the liquor employed.

The adulteration of wines and spirituous liquors generally is a very important subject from a sanitary point of view, but can be but briefly touched upon. The business of supplying the materials used in falsifying alcoholic beverages is so extensive, and these substances are so much in demand, that it is reported these compounds were kept for sale in England by a class of dealers called brewers' druggists. According to Hassall, these persons issued regular price-currents, and made a business of sending travellers all over the country with lists and samples, exhibiting the price and quality of the goods manufactured by them. Among the substances sold by these parties for flavoring and giving strength to alcoholic liquors, were found to be *Cocculus Indicus*, or fish-berries, so called because they are used in the East to catch fish by poisoning the water in which they swim; grains of paradise, red pepper, ginger, orange-peel powder, honey, hartshorn shavings, nux vomica, gentian, chamomile, orris-root, juniper-berries, angelica-root, and bitter almonds. To these modern chemistry has added many of the compound ethers. A writer in one of the Massachusetts Board of Health reports, upon this subject of liquor adulteration, states that although from the nature of the case it is very difficult to obtain all the



facts respecting an illicit traffic of this kind, he had fortunately obtained a circular from a firm of brewers' druggists in the United States, which recommended any practical man to save the hundreds of dollars which he was now paying to others for preparing his whiskies, brandies, gins, and so forth. It was announced that these recipes embraced the most accurate and practical directions for the convenient preparation of the various beverages, in large and small quantities; that but one recipe was given for each article, so that there need be no expensive experimenting; the ingredients recommended for flavoring and coloring were all easily procurable, perfectly harmless, and could be used with the utmost confidence; moreover, that special care had been taken so to arrange the recipes that no expensive apparatus was necessary—in fact, the majority of all the formulæ might be prepared by simple mixing, and that liquors made according to these recipes so closely resembled the genuine that they often could not be distinguished from them; that they answered for all the same intents and purposes, as the flavors for preparing them were identical with those which are formed naturally during fermentation, for modern chemistry, which has discovered the existence of these ethers in wines and distilled liquors, has also found out other and more abundant sources for them, rendering it highly advantageous from a pecuniary point of view to employ the latter.

So much for the advertisement, which obviously has a very inviting aspect to every dishonest barkeeper, who may have all the will, but only half the brains needful, to successfully swindle the thirsty public. To give a sample of these boasted recipes the following may be quoted: For forty gallons of port wine, take of port wine ether, four ounces; aromatic tincture, eight ounces; tincture of rhatany, eight ounces; tincture of orris, twelve ounces; simple syrup, three gallons; rectified spirits, three gallons; wine coloring, two gallons; plain or raisin wine, or fermented cider, thirty-two gallons. To improve this, add five gallons of imported port wine, and instead of the wine coloring, elderberry, cherry, or huckleberry-juice can be used, either wholly or in part. The flavors and ethers mentioned are stated to be sometimes mixtures of two or more of the compound ethers, experience teaching the advertiser the kinds, and the proportions of each kind, necessary to produce the taste of the wine or other liquid it is desired to imitate. In answer to a question from the Boston author of this article, he was informed that, whilst good judges might not be deceived into thinking that wines and liquors thus manufactured were genuine, he need have no fear that the ordinary run of customers would discover the substitution, and could dispose of the artificial liquors to all but his finest trade.

This report gives an insight into a gigantic scheme of fraud, which is doubtless still carried on upon an immense scale over the whole country. Such constant adulteration of wines and liquors, with deleterious or even



poisonous drugs, is a further and cogent argument in favor of that rigid temperance which many true philanthropists feel ought to be carried to the verge, if not yet over the border-line, of total abstinence.

### **Injurious Effects of Tobacco.**

Although tobacco is not an article of food, some of its active principle generally enters the stomach when chewed or smoked, so that its effects upon the system may be advantageously considered in this section. When Columbus and his followers landed in Cuba, in 1492, they were much astonished to behold the natives smoking tobacco. At first it seemed a wonderful phenomenon to the astounded Europeans, but with a swiftness most remarkable this practice of the New World spread over the different countries of the Old. Why it should be so rapidly adopted it is difficult to say; and though a thorough smoker is miserable without his pipe or segar, he would have some difficulty in explaining the reasons for his attachment to the drug. The deprivation of this narcotic is severely felt by those who are accustomed to its use, much more, it is said, than the want of alcohol by temperate drinkers; and by this peculiar fascination, which "the weed" appears to exercise over its devotees alone, can we understand why such a vast number, of even educated men, should daily use a substance so positively injurious, uncleanly, and offensive. Tobacco is in itself a deadly poison, acting powerfully upon the heart and nervous system. The oil of tobacco or nicotine, its active principle, will quickly kill a small animal, in the dose of a drop of the former, or half a grain of the latter preparation, if merely placed upon the creature's tongue. The immunity which tobacco users frequently enjoy, for a time at least, from obviously injurious results, is probably due to the fact that nicotine finds its way out of the blood by way of the kidneys very swiftly, and is thus eliminated almost as rapidly as it is absorbed. It is well known that an excessive consumption of tobacco will produce nausea and depressing sickness even in those who are well habituated to its use, showing the poisonous nature of its principle; and if most smokers had been guided by the delicate hint their stomachs gave them, the first time they tried a pipe, to abstain from that sickening luxury, devotees of tobacco smoking would be rarely met with. Still men may be smokers for half a century or more, and yet, after the first few trials, experience no unpleasant consequences from their indulgence in the weed. On the contrary, devout smokers will often claim that "burning their idol," in the process of smoking, has a soothing and composing effect upon the mind and nervous system, aids their digestion, and materially contributes to prolong their lives. In Germany, the practice of smoking is now so universally prevalent, that the question of the effects of tobacco upon Teutonic development is well worth the consideration of some master-mind among that philosophical people. In the late war with France, it is stated that so much

tobacco, or so many segars, were demanded from the different conquered towns, as the Germans passed on in their victorious march to Paris, as unfailingly as were provisions.

The action of tobacco upon the heart is in some persons a very serious one, so much so that a peculiar disease, called smoker's heart, is described in medical works. This term is applied to an irregular and rapid action of the heart, brought on by excessive smoking, or by the use of a tobacco stronger than the patient is accustomed to. It generally passes away with abstinence from its cause, but will often reappear if the habit of smoking is again indulged.

Although it must be admitted, even by the enemies of tobacco, that upon a great many strong and vigorous people, especially those of bilious temperament, the moderate use of it is a great luxury, which can be indulged in, after manhood is attained, without any perceptible injury to health, there is no question about its generally deleterious action upon the young; and the objection to its use by boys and youths, who have not ceased their physical development, is thoroughly well founded. Even if it is in moderation a harmless luxury for men, facts prove that it is quite the contrary for growing youths. Like indulgence in alcohol, it arrests their bodily development, and not only do they become stunted and withered in their physical aspect, but an enervated type of manhood is the result of too early submission to the habit of indulgence in this kind of neurotic stimulation. In some instances we may no doubt observe quite the reverse of this, and see that the use or rather the abuse of alcohol and tobacco is the consequence of a precocious and early development, an unfolding, however, which is not by any means that of a lofty type of humanity. Tobacco, then, although often a harmless associate for grown men, is a dangerous and seductive acquaintance for boys. In the United States it is rare to see women smoke, although in certain sections of the country the practice of eating snuff, or "dipping," as it is called, is said to be quite prevalent among females of the lower class, and is equally injurious to health with the practices of chewing and smoking. In France, however, smoking is not infrequently indulged in by the female sex, and a recent author declares that the pernicious effects of tobacco upon women and children who smoke are incontestable, and that the use of this substance, even moderately, by children and females, often produces an alteration of the blood, and the principal symptoms of anæmia, such as pallor of the face, emaciation, palpitation, and intermittent contraction of the heart, reduction in number of the red blood corpuscles, dyspeptic symptoms, and so forth. The ordinary treatment of anæmia affords no benefit, as long as the habit of smoking is continued; but the symptoms of impoverishment of the blood promptly disappear, often without leaving any trace of their presence, on giving up the habit, provided it has not been continued long enough to cause structural change in any important organ of the body.

## CHAPTER IV.

# THE EXTERNAL ENEMIES OF HEALTH.

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### Heat and Cold as Causes of Disease.

We come next to a consideration of the external causes of disturbance of health, among which heat and cold occupy a prominent position. In the northern parts of the United States, the latter of these two agencies is by far the more fatal to human organisms; in the belt of country corresponding with the Middle States, cold also causes a large proportion of the deaths; whilst in the latitude of the Southern States, heat is commonly, and cold but rarely, in comparison, the means of destroying life.

It is a matter of the commonest observation that, of half a dozen persons in average health, similarly exposed to the same general cause of disease, such for example as cold, one may be attacked with bronchitis, a second with simple cold in the head, a third with inflammation of the kidneys, a fourth with inflammation of the lungs, a fifth with pleurisy, and a sixth with neuralgia of the face. The explanation of this seeming inconsistency is to be found in the study of predisposing causes, such as hereditary influence, as distinguished from the exciting causes, such as heat and cold. The former of these agents may be compared to the gradual accumulation of fire-damp in a mine, whilst the latter have been likened to the lighted matches which bring about the sudden and fearful explosion, for which preparation had long been going on. By this is meant, of course, that the reason the first patient mentioned above in illustration would be affected with bronchitis, is because he is predisposed to affections of the lungs, or, to use a common phrase, his lungs are his weak point; in the same way the third patient might have nephritis, in consequence of the action of an identical exciting cause, because his kidneys were predisposed to inflammation; and in like manner the last sufferer might be affected with neuralgia of the face because, perhaps, one or more of the nerves of his teeth were uncovered by decay of the dentine, and being unprotected, were therefore irritable. It is obvious at once that these predisposing causes are the obscure but terrible agencies which



bring about the extinction of the unfit, described in the introduction to this work. And one of the greatest fields of usefulness which a systematic study of predisposing causes opens is, as then hinted, in the instruction which it affords as to what particular exciting causes it is vitally important for each individual to counteract and avoid.

As a general rule, predisposing causes only induce a liability or tendency to certain forms of disease, whilst exciting causes, acting on persons already predisposed to particular diseases, are apt to determine their occurrence. But predisposing causes may either, in some instances, be alone sufficient to give rise to maladies, or, when of medium intensity only, they may simply suffice to place the human system in a condition favorable for the occurrence of disease; in the latter case the disease develops, when exciting are added to the predisposing causes. Thus, for instance, in the example of a person who is under the influence of the predisposing causes favorable to the occurrence of inflammatory rheumatism, if under these circumstances he is exposed to some unfavorable changes in the weather and they bring on an attack of the rheumatic affection, the exciting cause, to wit, the atmospherical vicissitudes, would not by itself have been powerful enough to give rise to an attack of rheumatism, nor would the former influence, that is to say, the predisposing cause alone, have been sufficient, perhaps, but conjointly they occasion the disease. Thus exciting causes, as before remarked, act the part of a torch when everything is ready for the explosion. In this way it is manifest that predisposing causes determine the nature of a disease, and exciting causes the date of its occurrence.

#### Heat as an Exciting Cause of Disease.

Heat may begin to act as a disease-producing agent as soon as a temperature above that which is ordinarily agreeable to our feeling, that is to say,  $70^{\circ}$  or  $80^{\circ}$  of Fahrenheit's scale, is attained. The primary effect of exposure to a heat of  $90^{\circ}$  or  $100^{\circ}$ , as can best be observed by examining a patient in a hot bath of that degree, is decidedly stimulating, and, if the influence is continued or increased, a febrile condition may be set up, of which a good illustration is met with in thermic fever or sunstroke. The disturbing influence of heat on healthy life is primarily displayed in exaggerating the pulse and heart's action, quickening the respiration, and so forth; but beyond a certain degree it loses its vital for its chemical effect, and perverts not only the action of the organism, but also the organization itself, from the natural condition, as is seen in burns and scalds. These local disorganizations of tissue furnish pathologists with admirable illustrations of the exact mechanism of external agencies in disturbing the perfection of perfect organization in perfect action, and the whole process has been most accurately studied under the microscope.

Some curious results of experiments upon animals, only justifiable by

the light they throw upon this important subject, and thereby aid us in avoiding the causes of disease and in curing these diseases in human beings, are very instructive in this connection. Majendie found that animals exposed to a high temperature experience, first, a notable acceleration of circulation and respiration; second, a sensible diminution of the total weight of the body, a decrease which, in dogs, is rather the result of the abundant exhalation of fluid from the lungs than of that from the skin; third, if the heat is prolonged they exhibit great debility, and finally lie down and die in evident suffering. Another remarkable fact is, that living animals exposed to a high temperature become heated throughout all their tissues equally, and that only to the extent of ten or twelve degrees before death takes place, whilst recently killed animals behave like other inert bodies, becoming heated from part to part and to an indefinite degree. This curious circumstance is due to the transference of heat from the surface of the body by the circulation of the blood, which in its turn is controlled by the heat-centres of the nervous system, as will be explained a little further on.

In whatever temperature animals are placed, it appears that they are unable to survive a heat above  $110^{\circ}$  or  $112^{\circ}$  inside their own bodies, and all die with the same symptoms and the same changes of structure, consisting in particular of a special alteration of the blood, by which it becomes black, partly incoagulable, and more liquid, its fibrin being rendered less consistent and tenacious than in a healthy state. Bernard concluded that animals exposed to an elevated temperature succumb, when their blood becomes overheated, from eight to twelve degrees hotter than normal, and that death occurs from a cessation of contractility of the muscles of organic life, the pulsations of the heart and the vermicular movements of the intestines ceasing. The muscular tissue is veritably killed, and so thoroughly that, if examined immediately after the animal expires, it is found insensible to the ordinary stimulants of muscular action, such as electricity. In creatures thus destroyed by heat, the cadaveric rigidity or stiffness of the corpse comes on very soon, this rigidity being due to the coagulation by heat of the syntonin or muscle-juice, which takes place at about the temperature of  $110^{\circ}$  Fahrenheit.

These experiments upon inferior animals, which, cruel as they unfortunately were, inflicted far less prolonged torture than is frequently imposed upon game and fish for mere amusement by sportsmen, or by cooks upon lobsters and terrapin for the mere gratification of the palate, have been of great benefit to mankind, by aiding to establish the treatment of typhoid fever by cool baths and cold sponging, which has undoubtedly saved many human lives and a vast amount of human suffering.

The effect of heat upon human beings varies very much, according as the air by which it is applied to the surface of the body is dry or moist.



More than a hundred years ago, a baker's daughter astonished two French *savants* by entering into an oven, the temperature of which was estimated at about  $264^{\circ}$ . She remained about twelve minutes in this excessive heat without being much incommoded by it. This experiment was repeated several times, it is stated, on another girl with the same success. Early in the present century, a French observer, experimenting on himself, found that he could endure for seven minutes a temperature of  $229^{\circ}$ , and a companion bore a heat of  $240^{\circ}$  for eight minutes. In another series of observations, a young man remained for twenty minutes in a stove where the temperature of the air was  $210^{\circ}$ , without great inconvenience; but his pulse, which was commonly seventy-five, ran up to one hundred and sixty-four per minute, before he left this torrid atmosphere. When the surrounding air is moist, a much lower temperature is insupportable, and Berger found himself obliged, in twelve minutes and a half, to come out of a vapor-bath in which the heat had risen from  $106^{\circ}$  to  $128^{\circ}$ . He was weak, tottered on his legs, and was affected with vertigo, and the debility, with intense thirst, lasted the remainder of the day.

These investigations are of great practical value, as demonstrating the exact dangers to which such artisans as bricklayers, carpenters, and others who are compelled to work in the summer sunshine, become exposed. In July and August, the temperature in the sun's rays often rises to  $120^{\circ}$ , or even  $130^{\circ}$  in the hottest part of the day, and it becomes then quite frequently a matter of life and death whether men will or will not remain under shelter during the dangerous period between eleven and four o'clock. The moisture of the air at the time of exposure to overheating of the blood has a good deal to do with the relative safety of such a venture, as is shown by Berger's experiments upon himself. Besides the injury often experienced by workmen in the sunshine during summer, we find among engineers and firemen upon steamboats and steamships, serious effects often result from this same cause of overheating. Dr. Turner, of the United States Navy, says that whilst the temperature of the engine-rooms of ocean steamers is often highly elevated, that of the fire-rooms must frequently far exceed it. In one vessel, he states the temperature at which the firemen and coal-heavers worked was  $167^{\circ}$  F., with an average external temperature of  $84^{\circ}$ . The highest recorded temperature in this series was  $181^{\circ}$ , with the external air at  $86^{\circ}$ , and the lowest was  $149^{\circ}$ ; but in one instance the temperature of a thermometer encased in wood stood at  $198^{\circ}$  F. As a direct consequence of exposure of the men to great heat in the engine- and fire-rooms, a disease called "fireman's heart" is developed, and is characterized by a condition of weakness, with distressing palpitation of the heart, with other symptoms of failure in the muscular power of this important organ. Besides these dangers to real workmen, military evolutions, parades, and other civic displays in hot weather, often subject mere pleasure-seekers to great dan-



gers from overheating, and for hygienic reasons, Dr. Obernier recommends that, when the thermometer marks over  $86^{\circ}$  or  $88^{\circ}$  in the shade, all exercises of troops or men in masses should be arrested.

The reason that injurious effects from overheating are not far more frequently met with is that, in human beings of ordinary health and vigor, furnished with an ample supply of water, the equilibrium of temperature disturbed by the artificial heat is constantly restored by an increased flow of perspiration from the skin, and an augmented exhalation of watery vapor from the lungs, in such a way that the internal heat of the body is not raised, except to a very slight extent.

### Production of Animal Heat and Its Disturbances.

It has already been explained that the heat of the human body is produced by the gradual combination of carbon of the tissues, derived from the food, with oxygen absorbed into the blood from the respired air. In other words, the source of all the natural bodily heat is in the slow burning charcoal fires in all parts of the animal frame. This heat is distributed by means of the rapidly flowing blood, the flow of blood being largely under the control of the nervous system; one particular part of which, in the underpart of the brain, seems to have for its duty the regulation of the bodily temperature, so as to keep the internal vital organs as near the heat of  $98.4^{\circ}$  Fahrenheit as possible. This duty is so important that, as previously mentioned, an increase of from thirteen to fifteen degrees above this point almost infallibly destroys life by stoppage of the movements of the heart. Even a variation of two or three degrees, in the general temperature of the human body, interferes with most of the functions, as is shown by the headache, thirst, and loss of appetite accompanying even a slight feverish disturbance.

The temperature of the human body must obviously depend on the relations existing between the amount of heat generated in the tissues and organs, and the amount allowed to escape at the surface of the skin, and these must closely correspond, in order that the heat of the body remain uniform. Both these factors are found in practice to be very variable. Every increase in the activity of the muscles, as in gymnastic exercise and labor, or of the liver in digestion, and so forth, causes a greater production of heat, whilst a fall in the external temperature of the air, a decrease in the moisture of the surrounding atmosphere, or a diminution in the thickness of the clothing, causes a greater loss of heat from the surface.

The maintenance of a uniform temperature may then be accomplished, first, by variations in the heat-production, so arranged as to make up for the irregularities of expenditure; or, secondly, by variations in the heat-loss, so as to compensate for the differences of heat generated inside the system. Since the temperature and moisture of our surroundings are con-

stantly varying between tolerably wide limits, the amount of heat given off by our bodies must greatly vary in a corresponding manner at different times. In cold weather a greater quantity of heat is lost, in comparison with that which escapes from the body when the air is dry and warm. The presence of a considerable amount of moisture in the air reduces the evaporation, and consequent loss of heat from the skin and the pulmonary mucous membrane, and complete saturation of the air with moisture may entirely prevent this relief to the system. It is for this reason that, as already mentioned, man endures dry heat much better than that which is moist. If the heat generated inside the body had to make up for all the heat lost on the surface, one would expect to find a correspondingly great difference in the amount of heat-production at different seasons of the year, and we have some evidence, in the keener appetite and the consequent use of more food, especially of fatty food, and the natural tendency to active muscular exertion during cold weather, to show that a greater amount of combustion does take place in winter than in warm summer weather. But if the preservation of a uniform body temperature depended absolutely upon the variations in the amount of heat-income following those of the heat-expenditure, we should find it impossible to set our muscles or our glands into action, except when the external temperature was such as would enable us easily to get rid of the increased heat following their activity. Hence it is probable that variations in heat-production have little regulating influence. On the other hand, we know that the amount of heat-expenditure may be varied by arrangements of the animal economy, which are like the governor of a steam-engine, almost self-regulating. It has already been stated that the major part of the heat is dissipated from the parts in contact with the air, namely, the skin and the air-passages. In these places the warm blood is exposed to the cool air, and therefore loses much of its heat by the three processes in which cooling is effected, that is to say, by radiation, conduction, and evaporation. Of course, the greater the quantity of blood exposed for cooling, the greater will be the amount of heat lost in a given time by the body as a whole. The compensation for external variations in temperature depends then, during health, chiefly upon variations in the cooling of the blood, which are brought about in the following ingenious way: When the temperature of the air rises much above the average, the escape of the heat, and consequent cooling off at the surface of the body, is correspondingly hindered, and as soon as the general body temperature begins to rise, as a result of this retention of caloric, we have produced by the warmer blood, partly through the stimulation it causes to the heat-centre and its subordinates, first, a quickening of the breathing, which increases the amount of cold air to be warmed and saturated with moisture in the air-passages, and thus facilitates the escape of surplus caloric; second, there occurs a relaxation of the minute arteries of the skin, so



that a greater quantity circulating near the cutaneous surface is exposed to the cooling influence of the air; third, greater frequency of the heart-beat comes on, by which also a greater amount of blood is supplied to the air-passages and the surface-vessels, and commonly an increase in the amount of sweat poured out on the skin, affording opportunity for greater surface evaporation. But before the blood can become much warmer by the influence of the increased external temperature, the warm air, by acting as a local stimulus to the skin, brings about certain changes independent of the body temperature, which in themselves tend to check the disposition to an abnormal rise. This can be shown by the local application of external heat, by means of which a rush of blood to the skin and a copious sweat-secretion may be induced in a part. This is brought about by impulses sent directly from the skin to nerve-centres, which control dilatation of the blood-vessels and activity of the sweat-glands. If only a small part of the body be warmed in this way by artificial heat, only a local effort is made to cool that part, and this has but little influence on the general body temperature.

When, however, the atmosphere becomes very warm, all the blood-vessels of the skin dilate simultaneously, and the escape of heat is greatly increased; whilst at the same time so much blood is occupied in circulating through the skin, that the deeper heat-producing tissues, such as the muscles, the liver, and the kidneys, are supplied with less blood, and generate a smaller quantity of heat. Thus a marked rise in the external temperature, which at first sight would seem to impede the escape of heat from the body, really facilitates it by causing a greater exposure of the blood to the cooler air, and a greater quantity of moisture to be evaporated from the warm skin. When the temperature of the air reaches that of the body, as it does sometimes in the middle of the day during July and August, the only way of disposing of the heat generated in the body is by evaporation, for radiation and conduction become impossible. In man, where the cutaneous moisture is very great, the external heat of even a very hot day, whilst little exertion is made, seldom causes marked hurry in the rate of breathing; but in animals thickly covered with hair, and incapable of much perspiration from the skin, external heat, of even moderate degree, evidently hastens the respiration, as may be seen by the panting of a dog on a very warm day, even when the animal is at rest.

Almost more important than the contrivances for facilitating the escape of heat in warm weather, are the arrangements for preventing its loss when the surrounding air is unusually cool. In this case the cold, acting as a stimulus to the nerve-agencies which contract the small arteries, causes the blood to be in great measure shut off from the cutaneous surface, and makes it retire to and fill up the deeper organs, which immediately go to work producing more heat. The comparatively bloodless skin and the underlying fat then act as a non-conducting layer or



coat of armor, protecting the warm blood from being cooled off by the cold air. At the same time the secretion of sweat is checked by a special nerve-mechanism. Here too the cold air, which would soon rob the moist surface of its precious caloric, checks the secretion of fluid, and thereby nullifies its effects in that direction, thus beautifully aiding the body to maintain its natural standard temperature.

The chief agencies which regulate the bodily heat belong, therefore, to the expenditure department, and may be stated as, first, variation in the quantity of blood exposed to be cooled, and second, variation in the quantity of moisture exposed for evaporation. These regulators have to compensate not only for differences of external temperature in the external heat, such as depend upon the changes of climates and seasons, but also for great fluctuations in the amount of heat produced by tissue-change in the interior of the body.

The regulating power of the skin and its co-workers, the lungs, seems to be adequate only within certain limits for the perfect maintenance of a uniform temperature. When these limits are passed, by the rise or fall in heat of the surrounding air, the preservation, for any great length of time, of the standard temperature of  $98^{\circ}$  for the human body becomes impossible. These limits vary very much in different animals, many of which have special coverings protecting them from external influences, and thus retaining their warmth for their whole lifetimes, in an external temperature of the air or water in which they live seldom above the freezing-point. In man the limits vary very much, according to age, idiosyncrasy, constitution, and so forth, different individuals being differently affected, and the same one differently at different times. Thus, for example, both in infancy and old age these limits are very much narrowed. On the average it may be stated that, for about twenty degrees above and below the body-temperature, our skin-regulating machinery is competent to do its work, but beyond these limits external changes of temperature raise or lower our bodily heat, and, if continued, become injurious to health or even fatal to life, as in the experiments upon men and animals already detailed. Of course, by imitating with clothing the natural protection of hair, wool, or feathers, with which some animals are endowed, we can aid the natural regulating agencies, and bear much greater extremes of temperature with safety and even comfort.

It surprises many people to hear that their bodies are always of the same temperature, no matter how hot or cold they feel; but practically this is the case for the whole body taken in its entirety during health. When we feel hot, our cutaneous blood-vessels are full of warm blood, and this communicates to the ends of the sensory nerves in the skin the sensation of general warmth. On the other hand, when the blood-vessels of the skin are relatively empty, the terminal ends of the sensory nerves are directly affected by the cold of the external air, and convey the

opposite sensation to the brain. Since the full or empty state of the vessels generally depends on the heat or cold of the surrounding air, we get into the way of considering its being cold and ourselves being cold as if they were the same thing. That such is not the case, however, is shown by the fact that we can make ourselves warm on a frosty day by violent exercise, because we generate so much heat by muscular action that the cutaneous vessels have to be dilated in order to get rid of the excess, and thereby regulate our bodily temperature down to the natural standard, and hence we have the sensation of being warm. Our feelings, when we say we are warm or cold, simply depend, therefore, upon our cutaneous blood-vessels being at the time full or empty of warm blood.

### **Dangerous Effects of the Sun's Heat.**

The exposure of the human body to the direct rays of the sun in hot countries, and especially for a long time continuously, is apt to result in more or less serious disturbances, such as congestions or hemorrhages of the brain, acute and chronic meningitis, and so forth. Although further and more exact observations are needed, it appears probable that the direct rays of a hot sun falling upon the skin interfere with perspiration, and so prevent, to a considerable extent, the natural cooling process by evaporation. The same effect is no doubt produced to some extent underneath a close and unventilated cap or hat, upon which the hot sunshine of a summer day beats unhindered. Hence it is very important to avoid this kind of exposure to disorders of the brain, which are exceedingly fatal when they do come on. The effect of the direct sunshine upon many persons' skins, until they become somewhat accustomed to its action, is to produce the painful cutaneous affection, sunburn, which, although it does not generally go beyond the first degree of a burn, may occasionally result in the formation of large blisters and running sores of considerable magnitude. The simple precaution of keeping the skin protected from the sun's rays is all that is necessary to avoid this derangement of health, which, although only skin-deep, is sometimes quite painful.

Exposure to a high natural temperature in the shade is much better supported by man, in consequence of his being provided with the wonderful heat-regulating power which has been minutely described. Among the important symptoms which make their appearance may be mentioned, first, the thirst becomes intense, almost intolerable, because the animal economy experiences intense need of water to replace the water given off by the skin and pulmonary mucous membrane; secondly, the intestinal secretions are diminished, causing the appetite to become less keen, so that a necessity is felt for stimulating the languid functions of the stomach with exciting food and drink; an exception to this rule respecting the intestinal juices seems to exist, however, in regard to the bile, which



is increased in amount, and this is accounted for partly by the general use of stimulating articles of diet in hot seasons and hot climates, and partly by the acute and chronic disorders of the alimentary canal, resulting from changes of regimen and temperature; third, unless fruits and other laxative foods are eaten largely, constipation is almost habitual in warm climates, and this is attributed as a direct result to the scantiness of the intestinal juices; the secretion of the saliva and of the renal discharge are also notably diminished; fourth, the muscular feebleness observable in those who inhabit hot countries is referred in part to the excessive perspiration from the skin, and partly to the fact that the excesses of debauchery seem to be stimulated by a high temperature; fifth, of the three great functions of the brain, two are often exalted in their action, that is, the intellectual faculties are frequently rendered more alert and energetic, and the sensibility is endowed with a more quickened and acute perception. As to that of locomotion, it is apt to be lessened in activity, as already stated.

#### **Danger of Sunstroke.**

The most imminent danger to health, and indeed to life, from the effects of exposure to solar heat, is that of sunstroke, or thermic fever, as it is also called. This disease is the result of exposure to a temperature beyond that which the heat-regulating power of the system can compensate for, as explained a few pages back, and its very great fatality, which amounts to forty or fifty per cent. of the cases, renders it very important to guard against its onset. Although most sunstrokes occur during the hottest parts of the day, and in persons who are exposed to the direct rays of the sun, yet instances have frequently been reported where the patients were working in hot rooms, and in one case, in Philadelphia, a night-watchman was, paradoxical as it may seem, sunstruck at midnight. The early symptoms are faintness, thirst, great heat and dryness of the skin, with prostration. In many cases, vertigo and a sense of tightness across the chest are complained of. Later on, palpitation of the heart and stupor appear, but these, with the appropriate treatment, will be more fully detailed in the second part of this work. Sometimes the affection comes on very insidiously. A workman in the hot sun will perhaps be noticed listless and stupid, but makes no complaint beyond saying that his head feels a little queer; and yet in twelve hours he may be dead from sunstroke in spite of the best treatment. In several instances the individual, after exposure to the sun, has fallen down insensible, made one or two gasps, and at once died in a fainting-fit. On account of the difference in the treatment, it is important to make the distinction, or diagnosis, as it is called in medical books, between sun- or heat-stroke, and heat collapse. It must be admitted, however, that this is not always possible, as mixed cases, where the symptoms of sunstroke and heat-exhaustion are combined,



appear not very uncommon. The cause of heat-stroke appears to be simply the heating of the head especially, and of the blood generally, above the temperature of 110° F., at which, as already explained, coagulation of the muscle-juice occurs, and death results. This heating up of the blood and vital organs is produced by exposure to an external air temperature beyond the limit which the natural heat-regulating mechanism can compensate for. The obvious preventive measure of heat-stroke, then, is to avoid such exposure to an excessively hot sun and air; but where this precaution cannot be instituted, the following means of preventing sunstroke, and the other serious effects of excessive heat, are important. The body is to be bathed every morning in cold water, so as to insure a free and clean skin. All alcoholic liquors are to be avoided, since intemperance is an efficient predisposing cause, and a large proportion of the victims of heat-stroke are persons who drink freely, whether drunkards or not. Water, weak tea, lemonade, and other simple diluents, are to be partaken of in abundance. Dr. Smart states, that among soldiers on the march, the most frequent cause of sunstroke is a failure of the water-supply, aided by the chest-pressure of the various belts and straps, by which the soldier's load is suspended from his person. This was the case in the summer marches of the Army of the Potomac. If the water in the canteens lasted until the next opportunity of refilling them, so that the water imbibed and that lost by perspiration were equal in quantity, the men pushed along, faint from fatigue, perhaps, but in no danger from sunstroke; if, on the other hand, the supply failed, and the skin became dry, danger from sunstroke was imminent. Whether the symptoms of the attack in such cases depend on the loss of water from the blood beyond the limit consistent with functional activity, or on the increased heat consequent on failure of evaporation, is, says Dr. Smart, an open question, but of little interest in this place, as the preventive measure on both theories is an insured continuance of the water-supply, and the immediate means of restoration in individual cases are water affusions for skin-absorption and cooling, and water by the mouth as soon as the patient can swallow. Among the other precautions which conduce to safety from sunstroke are, that meals should be at regular hours, and composed of good, properly-cooked food. Natural perspiration should not be checked in any way. Light and loose flannel clothes are better than most other kinds. The head should be covered when exposed to the sun with thin folds of white linen or serge, and this covering may be kept wet with cold water if the heat is very great. A light-colored umbrella affords great protection. In the shade, the head should be uncovered as much as possible, so as to gain every advantage from the cooling effect of slight draughts of air. An important lesson may be learned in this respect from the fact that, in China, the inhabitants expose their closely-shaven heads to the hottest sun with apparent impunity. But when so doing,

they generally make vigorous use of their fans, as if they attached more importance to having a free current of air about their faces than to protecting their heads from the sun's rays. When, in spite of all precautions, there is experienced any sense of pain or tightness about the forehead, or dizziness, or weakness, the sufferer ought to retire immediately into the shade, lie down, and have cold water poured gently over the head. Until medical assistance arrives, he may drink freely of iced water or cold tea. On no account is bleeding to be practiced in true sunstroke, as it is a disease of depression, and not of over-excitement of the vital powers. A valuable precaution is putting a wet handkerchief, or a handful of green leaves, or a large cabbage-leaf, in the hat, so as to further protect the brain and its coverings from being overheated.

It is a circumstance worthy of note, that sunstroke occurs with far greater frequency in cities than in the open country. This is explicable from the fact that the temperature in built-up portions of crowded cities generally rises three or four degrees higher in narrow streets and alleys than in the rural districts, and that currents of air are, to a certain extent, obstructed, so that the evaporation from the skins of citizens, which has been pointed out as the great factor of the heat-regulating process, is less active and efficacious than in the open country. It is reported that the city of New York has had as many as sixty cases of heat-stroke in a single day, and that Tokio, Japan, has had one hundred, whilst here, in Philadelphia, a score of cases in twenty-four hours is not an extraordinary occurrence. Statistics show that, as soon as the thermometer gets into the nineties, cases of sunstroke are liable to make their appearance on the death-register; but as to their frequency with any particular degree of excessive heat, there is another factor, that of the relative humidity, which has a powerful influence. This will be readily understood in the light of the explanation already given of nature's method of cooling off the body by evaporation from the skin, and the obvious deduction is that, on a hot day, when the dew-point is low, as shown by the simple household test of the ready condensation of moisture upon an ice-pitcher, extraordinary precautions ought to be observed against sunstroke.

#### **Rules for Visitors to Hot Climates.**

The following excellent recommendations are given by Becquerel for those who are called, by business or duty, from a temperate to a torrid climate, such as that of the Southern States during the summer months: First, avoid with great care mid-day exposure to the direct rays of the sun, on account of the terrible effects its perpendicular rays produce. Do not go out of the house, or at any rate attempt to travel, during the heat of the day, and when such journey is imperative protect the head and back of the neck by some covering which reflects the sun's rays in a high degree, and also prevents, as far as possible, the nerve-centres from insola-



tion. Seek repose during the diurnal period of greatest heat, and avoid throughout the mid-day hours all severe mental occupation, which has a direct tendency to congest the brain and its membranes. Exercise, by walking or otherwise, should only be taken in the morning or evening, and two periods of sleep, the usual nocturnal one and a noonday nap or siesta, seem beneficial. Second, it is indispensable in warm countries to content oneself with a comparatively scanty and unstimulating diet. A circumstance, related by Robinson, shows how little nourishment is sometimes for a while required by man in hot climates. Some British troops during the war in India became short of provisions, and officers and men saw themselves reduced on a certain occasion to two ounces of rice per day. Notwithstanding their fears of starvation, they soon seemed to grow accustomed to subsisting on this limited amount of aliment, and for a considerable time, until relieved, the health of the division was excellent, and the number of sick unusually small, although, no doubt, the average loss of weight per man was well marked. Third, the habit of using gently stimulating baths, such as those of fresh, cool water or cold affusions in the morning on rising, or for vigorous persons who react well, just before retiring, so as to cool the skin and promote refreshing sleep, is highly agreeable and beneficial. Exercise should be moderate in amount, never severe or such as to give rise to the enormous perspirations which so readily exhaust the animal forces. Fourth, clothing should be thin, light in color loose and roomy in its construction, and preferably of a soft woolen or mixed linen and woolen fabric.

### **Cold as a Disease-Producing Agent.**

A second great external cause of disease is cold, which term is meant to designate any temperature below that which is most agreeable to the bodily sensations, or generally that below 70° Fahrenheit. This condition is a far more prolific cause of disturbance of health, throughout the northern part of the United States, at any rate, than its opposite extreme of temperature; indeed, it has been estimated that nearly one-half of the failures of health, short of actual maladies of a serious character which human beings are called upon to suffer, originate in taking cold; also, many of the acute and dangerous diseases have, as their exciting cause, at least, the check of perspiration which is produced by sudden exposure to cold, damp air. The effect of cold upon the human organism is profoundly depressing, both locally and to the general system. Under its local influence the tissues shrink, the capillaries circulate their blood less vigorously, the secretion of perspiration is suppressed, sensibility is impaired, and the part becomes pale from want of its usual supply of blood, or purple from the stagnation of venous fluid in the obstructed vessels. Extreme cold, such as we experience in the latitude of Philadelphia in severe winters,



may of itself cause death, but is more commonly fatal in its effects as we approach the polar regions. A remarkable illustration of this is given in the history of Captain Cook's voyages, where is narrated the story of an excursion made by Dr. Solander and nine others over the mountains of Terra del Fuego. Dr. Solander explained to his companions before setting out the evil effects of intense cold, and especially cautioned them against giving way to any strong desire for sleep, with which they would very likely be affected, telling them it was vitally important, for them to keep in active movement, and remarking, "whoever sits down will sleep, and whoever sleeps will wake no more." Notwithstanding all this, he himself, being probably less hardened than the rough sailors, was the first to experience this irresistible inclination to rest and sleep, and, in spite of his knowledge of the consequences, he entreated his companions to allow him to lie down. They, however, being aware from the information he had given them of the fate to which he would be subjected, urged him forward; but becoming exhausted themselves, were finally obliged to leave him behind, with two black servants, who had also grown drowsy. After a while, however, they returned to Dr. Solander, who was aroused, though with great difficulty, and carried to a fire which some of the men had succeeded in kindling at a little distance. Though he had slept but a few minutes, Dr. Solander very narrowly escaped death, and for a considerable period afterwards was deprived of the use of his limbs. The two negro men perished. Among the remarkable illustrations furnished by history of the fatal effects of cold on a grand scale, may be cited that of the last campaign of Napoleon, who entered Russia with an army of five hundred thousand men, and crossed the border on his return with scarcely thirty thousand, the largest portion of the remainder having perished with cold. Surgeon-General Hammond relates that it has several times occurred to him to notice the effects of cold, in producing numbness and drowsiness. On one occasion he was himself nearly overcome by an intense desire to sleep, produced by a sudden change in temperature, in which the thermometer fell, during about two hours, from  $52^{\circ}$  to  $22^{\circ}$  Fahrenheit. "I was crossing," says Dr. Hammond, "a mountain ridge in New Mexico, and if I had had much further to go, should probably have succumbed. As it was I reached a rancho in time to be relieved, though it was several minutes before I could speak. The sensations were far from being disagreeable, and with all these there was a feeling of recklessness of consequences that made it a matter of indifference whether life was preserved or not."

The evil effects of cold upon human life without proving immediately fatal are, perhaps, most obviously shown in the relations which pulmonary affections in different seasons bear to each other upon the death-register. For example, a sudden fall of temperature is apt to be followed by a long train of ailments, such as catarrh, influenza, bronchitis, and other forms

of lung-disease, which a very brief inspection of mortality tables proves are fatal in great measure according to the age of the patients attacked. Thus it has been demonstrated that, if the rate of mortality following a fall of temperature below the freezing-point is considered as one in a thousand deaths for persons at the age of twenty years, it will be two out of a thousand at the age of twenty-nine; four out of a thousand at the age of thirty-eight; eight per thousand at the age of forty-seven, and so on, doubling with every nine years of life. We also find by these same records that certain diseases, such as bronchitis and pneumonia, have their greatest fatality during the first quarter of the year; that this fatality decreases during the second and third quarters, and again increases during the fourth quarter. The death-rate of other diseases, such as influenza, pleurisy, and quinsy, is in a great measure similarly influenced, and there are many other ailments which, although they originate independently of weather changes, have their intensity nevertheless greatly modified by the degree of cold prevailing during their course.

#### **Why Cold Proves Fatal to Elderly People.**

We find an explanation of the effects of cold in advanced life by estimating the forces of vitality at different ages. As already pointed out, when speaking of the subject of age as a modifying influence, the human body attains its fullest development at the age of thirty years, and at this period, if it be quite healthy, it generates by its own chemical processes, from the food which is eaten, so much force as will enable it, within given bounds, to work its own machinery, to call forth at will a limited surplus of extra power, and to supply a fluctuating heat-loss, which may be imposed upon it by contact with the surrounding air, or by other substances which it may touch and that are colder than itself. The body yields therefore, says Dr. Richardson, applied force, reserved force, and waste force; and these, under ordinary circumstances, are sufficient to maintain the perfect organism in effective life. So much active force gives the body power to perform so much labor; so much reserved force supplies it with power to perform a certain amount of extra labor, to meet emergencies; so much waste force enables it to resist the external vicissitudes of the weather, without entrenching upon the supply which is constantly wanted to keep the heart pulsating, the chest heaving in respiration, the glands secreting, the digestive apparatus digesting, and the brain receiving impressions and combining them into thought.

Let this distribution of force be disturbed, and straightway the life-power is reduced. If we use the active force too long we become exhausted, and must call upon the reserve; and if we still continue the process we fail at last, unless sleep forces itself upon us, and brings with the rest it assures a renewal of power. If by exposure to cold we are robbed of the



waste force quicker than we can supply it again, exhaustion is just as certainly produced; insufficient nervous control over the blood-vessel system succeeds, and therewith that congestive condition of the lungs and other highly vascular organs, under which death is so easy when exhaustion is severe. That the exhaustion should be more rapid in the man who has passed his prime is but natural. In the past his body has been growing and developing, and in the course of development he has used up an excess of force, commensurate with the demands of his growth. When he stops in development and stands on a fair level with the external forces opposed to him, then his own force, for a short time balanced, soon becomes second in command. Soon he grows enfeebled by the ceaseless conflict; the host of adversaries in external causes of disease gain inch by inch in their assault upon his citadel of life. He feels cold more tenderly; if his rest is broken, his demand for artificial heat is urgent; if he lose or miss taking food he fails rapidly; and returning to the facts above mentioned, in relation to the influence of external temperature upon mortality, these many sources of failure are the reasons why a fall in the thermometer sweeps away, as it were, our population so decisively in accordance with age.

It is wonderful how much long habit can accomplish in rendering man capable of supporting great extremes of cold. In the polar regions, where the mean temperature of the year may be as low as three degrees above zero, and where the thermometer for days together sometimes marks fifty degrees below that point, human beings are found enjoying life, subsisting entirely upon animal food, and dwelling in huts built of the snow which constantly covers the earth around them. We must admit, however, that the finest specimens of the human race are not met with in climates where these extreme low temperatures prevail. A mean annual heat of from forty to sixty degrees appears to be, in the present age at least, that under which man attains the greatest measure of physical and mental vigor, and which is most conducive to health and long life. Ability to resist low temperatures is very much in accordance with the character of the food taken into the stomach. The hydrocarbons, such as fats and oils, are most effectual in maintaining the heat of the body when it is subjected to intense cold. Thus the amount of oil, fat, and blubber consumed by the Eskimo and Laplanders is almost incredible, whilst, on the other hand, the inhabitants of very hot climates learn almost by instinct to avoid the use of fatty substances and animal food, living almost exclusively on fruits and starchy articles of diet.

There is no greater fallacy than the opinion entertained by many, particularly the young and vigorous, that winter, especially a sharp frosty one, is the most healthy season of the year. Very few persons seem to realize the fact that cold is the condition of death, and that both in warm and cold climates. It is our unconscious effort to retain our bodily tem-





*STATUE OF VENUS—The Ideal of Physical Beauty.*



perature at ninety-eight degrees that wears us out. To this temperature, commonly called "blood-heat," every cubic inch of oxygen breathed into the lungs to vitalize the blood must be raised by our own bodily heat, or life ceases. Since in cold weather the maintenance of a sufficiently elevated bodily temperature becomes very often a task too great for our strength, the advent of a severe winter is really more to be dreaded than the visitation of a pestilence. The saying, "heat is life, whilst cold is death," has often striking illustrations and confirmations in the weekly reports of boards of health. The death-rate rises and falls with the regularity of the thermometer—so many degrees less heat, so many more deaths, and *vice versa*.

Frequently, however, the effect of a week of low temperature is seen in an increase of the mortality for the following week, obviously because the cold takes a few days to accomplish its deadly work, even when no judicious effort is made by suitable medical treatment to counteract its effects. A recent sanitary writer declares, with an almost allowable exaggeration, that a cold is the beginning of everything that is bad, and therefore it is of the first importance to reinforce our means of resistance to cold, and the derangements which it causes, by every means in our power. It is not only advisable to retain by proper nutrition our animal heat at its best standard, and to prevent the escape of this heat after we elaborate it by suitably adjusted clothing, but we must also carefully regulate, as far as possible, the temperature of the air we breathe into our lungs. Many delicate persons, or even invalids, will venture out in frosty weather, provided they are thickly clothed, in the mistaken belief that if they are well wrapped up they cannot take cold. Such persons forget that no provision of thick coats and cloaks suffices to warm the air they draw into their lungs, until they are too late, perhaps, taught the lesson by a sore throat, a bronchitis, or a renewed attack of illness. Contrary to the opinion current among lovers of cold weather, a fire in the bed-room, or a little well-moistened warm air from a furnace, is cheaper and better than an attack of sickness; for owing to the inactive condition of the human body whilst sleeping, the circulation of the vitalizing blood is relatively slow and imperfect during slumber, and hence the danger of taking cold by breathing cold air, and especially the cold and damp night-air, is greatly increased whilst asleep.

Another method by which cold acts as a disease-producing agent is by checking perspiration, in the way already explained, thus preventing the escape of injurious materials from the blood by that great avenue of elimination, the skin, and also throwing more work upon the kidneys and lungs, the office of which is vicarious in great measure to that of the cutaneous surface. Still another and more direct effect of cold is the driving of the blood, as previously mentioned on page 231, from the blood-vessels of the surface, thus, as a necessary consequence, filling one or more



of the internal organs too full of the circulating fluid. Whichever one of these internal organs happens to be the weak spot of the individual, and unfortunately almost everybody is handicapped in his battle with the causes of disease by some such vulnerable point, is the one to suffer. And if affected, this weak organ, whatever it may be, is least apt to recover promptly from the temporary congestion so produced, and equally, of course, the most liable to become the seat of a serious inflammation—of pneumonia, if a man's lungs are his weak point, or of a nephritis, if his kidneys are least able to resist an attack of disease.

The suffering produced by, as well as the injurious effects of, cold are much increased by strong currents of air. Thus, in the Arctic regions, a temperature of seventy degrees below zero can be borne without much suffering if the air is at rest, whereas, if a strong wind is blowing, a much less severity of cold is unendurable. Dr. Kane assures us that, according to his experience in his explorations towards the North Pole, a still cold of forty degrees below zero caused less suffering among the men who were exposed to it, whilst on their journey, than zero weather accompanied by strong winds. This circumstance is very important to those who venture out into the winter atmosphere in cold climates, because a knowledge of the fact will often enable them to dress in accordance with the combined adverse influence of wind and low temperature. It is readily explained when we remember that the air is a poor conductor whilst at rest, so that the body cools very slowly when surrounded by a still atmosphere, but when in motion a fresh portion of air constantly takes the place of that which has been warmed by contact with the surface of the body, and thus greatly increases the rapidity with which the heat is abstracted. The partial application of cold by a draught of cold air to portions of the human body which are especially unaccustomed to it is highly injurious. Many persons will begin to sneeze, or be sensible of a sore throat, almost immediately, if exposed to a current of cold air striking upon the back of the neck. Even an exceedingly short exposure to cold air will sometimes give cold, as, for instance, in the case narrated, where a person going into a cold room without his coat contracted a severe catarrh, by an exposure of only four minutes. Feeling as he came from the room as if the imprudence he had been guilty of was about to be justly punished, he noted very exactly the time of exposure.

#### **Clothes as Protections from Disease.**

Clothes constitute the principal defensive weapons which man employs in his struggle for existence throughout the Frigid and a considerable portion of the Temperate zones. Whilst people generally speak of clothing from a moral and an ornamental point of view, ignoring its main purpose, which is to aid us in preserving our health, this latter mode of considering it ought to have the great pre-eminence. That this is not

the case is very unfortunate, because such forgetting of the chief object has subjected mankind, and especially womankind, to the rule of small and frivolous considerations, and the manners and fashions of the period frequently control the hygienic fitness of clothing. Morality and beauty cannot be created or preserved by dress—indeed, they depend upon it to a very small extent—these great qualities could even exist without it; but human beings, as they are, could not, or at least but barely and imperfectly, live in our climate without the protection of clothing, which is more indispensable to mankind, therefore, on account of health, than it is on the score of beauty and morality. Theologically, clothes were instituted to cover our nakedness; physiologically, they are utilized to protect us from the outside influences of cold. They vary from rags around the loins to thick suits of furs, according to climate and region. In Burmah, says Dr. Fothergill, the young grandee has himself magnificently tattooed, because in that country it would be inconvenient to have to wear clothes ordinarily as ornamental appendages. In Siberia and Labrador, the skins of animals with the fur unremoved are the common wear of the people. In fact, the development of dress and the part it has taken in the history of civilization form no unimportant subject of research for the scientific student of mankind.

In order to understand the true philosophy of dress, it is necessary to remind the reader that any object, as for instance the human body, placed in an atmosphere cooler than itself, at once begins to lose its heat in three different ways. The first of these, radiation, is that process by which heat is given off in all directions from a hot object, just as light is emitted from a luminous one. It is by this process that we warm our hands before a glowing fire, and the merest child knows how much slower would be this warming operation if a woollen screen were interposed between our fingers and the source of heat; in other words, if the stove were *thickly clothed*. The second process by which, under the circumstances supposed above, cooling of our bodies to the temperature of the air around them would be accomplished, is evaporation of moisture, such as perspiration from the surface, an operation in which, fluid being converted into gas, considerable heat is absorbed and rendered latent. The third mode, that of conduction, or direct conveyance of the heat from the extreme outer surface of the body to the particles of air immediately in contact, is the slowest of all in a still atmosphere; but if the air is in rapid movement, as it would be should the wind be blowing, so that successive cold particles of air were brought quickly against the skin, this might become the most rapid of all.

Now, it is plain to be seen that if we cover our bodies, we necessarily change the rate at which the natural cooling process goes on in all three of the modes just mentioned, because, in the first place, this covering which we have laid over the skin cuts off the radiation of heat to the



surrounding objects, such as the walls of a cellar, if we happen to be in an underground apartment, for example; in the second place, it interferes with the evaporation from the cutaneous surface, by confining a small quantity of air which soon becomes saturated with moisture beneath it; and in the third place, it limits the conduction of heat to the comparatively few particles of air lying in contact with our surface, by preventing them from flying away as they become warm, and giving place to colder ones. But, it may be asked, if clothes cut off the loss of body-heat by radiation, how is it that people often freeze to death with their clothes on, and why should we bundle ourselves up in thick costly furs when, according to this theory, thin linen coats would do just as well?

The fact is, that radiation is only prevented by clothing for the few seconds or minutes which are required for heat to pass through the fabric of the stuff, by the relatively slow process of conduction; as soon as this is effected, radiation to the cellar walls (to continue our illustration) begins again, and goes on with an activity in proportion to the rapidity with which the body-heat can pass by conduction through the linen coat or the fur cloak which we have put on.

Since, as is well known, the rapidity of radiation from one body to another depends largely upon the difference of temperature between them, it is quite possible for even thick wrappings to fail in preventing a fatal loss of bodily heat in extremely cold weather, because, in such a case, the radiation from the outside of the clothing, which Von Pettenkofer calls our "artificial surface," may thus be rendered so active, and this in its turn render the conduction through the clothes so rapid, that the body is as quickly and dangerously cooled as it would have been without any covering if the surrounding temperature were not so low. Furthermore, as the radiation from our "external surface," if that is a linen coat, is rapid (other things being equal), because heat radiated from the body is quickly conducted through its texture, whilst radiation from an "external surface" of fur cloak is proportionately slow, because bodily heat is only very gradually conducted through its substance, it is easy to see why we should impoverish ourselves to purchase fur cloaks for each member of the family, especially when such hirsute investments are all the fashion, as they are now.

Besides protecting us in this way from being fatally chilled, clothes add marvellously to our comfort by enabling us to change the place where the loss of heat into the surrounding air occurs, from our own sensitive skin to the insensible outer wraps of our "artificial surface." In this is imitated Mother Nature, who has clothed animals with hair, and birds with feathers, both substances that are unsupplied with nerves, and therefore incapable of feeling the loss of heat any more than coats and cloaks can do. If, however, the cold is severe, or the clothing insufficient in thickness, so much heat-loss occurs at the surface of the skin that the sensation of



cold is experienced, and the physical effects of low temperature, especially the contraction of the smaller blood-vessels which lie just beneath the skin, become visible. As already mentioned, when speaking of cold as a cause of disease, this narrowing and consequent diminution of capacity of the external blood-vessels necessarily increases the bulk of blood in the deep-seated vital organs. Such a condition of being too full of blood, called congestion, constitutes the first stage of inflammation, and one can therefore readily see why exposure to cold, when insufficiently clothed, so often results in inflammation of the lungs or pneumonia, inflammation of the kidneys or Bright's disease, and so forth. The processes of hardening oneself and making oneself tender, have already, as regards cold air, been explained in the appropriate place, and need not be repeated; but the warning against trying to gain the former of these accomplishments for infants, or for any individual whose system is out of order in any part, can scarcely be too often insisted upon.

By careful adaptation of the thickness of our clothes to the coldness of the weather, we can, of course, avoid to a great extent the necessity of endeavoring to harden ourselves to the atmospheric vicissitudes; but every person's individual experience must be a law to himself in this particular. Many people find that, in mild seasons, they endure going without an overcoat, for example, to the middle or end of December, until, after some unusually long and severe exposure, or an exposure whilst otherwise out of health, they take cold, and are obliged to envelop themselves carefully and thickly for the rest of the winter. Few sanitary rules, in fact, require obedience more inexorably than that which commands us, after having once commenced with a certain thickness of outside winter wraps, to continue with the same until spring returns. The mere wearing of a thinner necktie than usual on a winter's day has been known to bring on severe cold and sore throat, and it is probable that thousands of cases of consumption among females take their rise from a few hours' exposure of the neck and upper part of the chest to cool air at balls and parties, by the costume absurdly called "full dress" in fashionable society.

### **Clothing as a Substitute for Food and Fuel.**

But not only is the danger of laying the foundations of disease from passing into cold air when too thinly clad to be considered, but it should be remembered that, according to the principles already enunciated, to keep up the heat of the body in winter, without the aid of warm clothing, requires a great expenditure of muscular and nervous energy, which is the equivalent of a large amount of life-force. Some people seem to be affected with a sort of mania for hardening themselves and their families, in apparent forgetfulness of the fact, that to counteract the influence of cold without the aid of broadcloth and furs requires this great waste of

nervous force, which, if not so exhausted, might be applied to far higher purposes. Had, for example, the nervous fluid which gave activity to the reasoning faculties of Sir Isaac Newton's brain, on the autumn day when he saw the apple fall from the tree, been called away from his cerebrum to energize the nerves of his skin, in consequence of his being too thinly clothed, we might never have had from him the discovery of gravitation, which has made his name so illustrious. And a distinguished Western divine once acknowledged that, with all the fire of his eloquence, he never could make much impression upon the minds and hearts of an audience if, at the time the sermon was being delivered, his hearers were suffering from cold feet. Not only is it superfluous, but injurious, to exhaust our powers unnecessarily when mere mechanical appliances like clothing will obviate the continuous wasteful expenditure of vital energy. Practically, persons in ordinarily good health will find it much more convenient to have all the different coats or dresses intended to be worn about the same time of year nearly equal in thickness, as a change to even a slightly thinner article of clothing is very apt to induce a severe cold, unless it is made in exact correspondence with a rise in the thermometer and a diminution in the relative humidity of the air. Leaving off warm clothing too early in the spring is well known to be a common cause of coughs and colds, and the reader can probably trace many of his own attacks of illness to want of prudence in this respect.

### Varieties of Clothing.

Among the materials used for clothes, those of animal origin, such as wool, silk, hair, furs, and skins, are all of them worse conductors of heat, and therefore warmer as clothing, than materials derived from vegetable sources, such as cotton, linen, hemp, and flax. Garments worn next to the skin are preferably made of wool or silk, because they absorb the moisture of perspiration readily, are bad conductors of heat, owing to the layers of air which they retain in their interstices, and they can be made very light and durable. Fabrics made of silk and wool combined are also very well adapted for underclothing, and next in order come those manufactured from silk and cotton, or wool and cotton, then muslin or calico, and lastly linen. Delicate people, and those past the prime of life, should always wear flannel or silk next to the skin summer and winter, a good rule for such being that they should leave off their flannels if the weather becomes very oppressive on the 30th of June, and put them on again not later than July 1st. Occasionally we meet with persons of weak constitution whose skins are too sensitive to bear the contact of woolen fabrics, without suffering from the so-called prickly-heat and other cutaneous eruptions. In such cases flannel underclothing lined with silk, or even with linen, is the proper resource. People who suffer from rheumatism, or who have inherited a rheumatic diathesis, even whilst in fair



health, ought always to wear flannel next to the skin, if it can be borne, and in cold weather should sleep in flannel night-dresses and between blankets. To workmen employed in hot workshops or factories, and to persons residing in warm climates, belts made of flannel are of great service, provided they are not too thick and heavy. The clothing generally, indeed, should be as light as is compatible with the power of sufficiently preventing by its aid the heat-loss, otherwise it encases the body too closely, checks evaporation, and is neither cleanly nor comfortable.

As regards protection from direct solar heat, white is the most suitable color, and next to it, gray. To wear black or dark clothing during hot, summer weather is therefore a mistake from a sanitary point of view, and persons who are in deep mourning, especially those who wear heavy folds of crape, often suffer serious depression and constant discomfort. In warm climates, linen is especially suitable as the coolest and smoothest of all materials used for clothing, but vests of silk, or of silk and wool, should be worn next to the skin. Linen and cotton materials have the further advantage of greater cleanliness, and, when of a light color, of imparting a cleanly appearance to the wearer's general aspect as well. During cold weather, overcoats, shawls, and cloaks should be worn out of doors, of course, but they should never be thick nor heavy when it is intended to take active exercise. Furs, as extremely bad conductors of heat, are very useful and highly prized in all cold regions, and for winter wear in this country. In order to keep out the wet, India-rubber waterproof garments of various kinds have become very popular; but as they prevent the escape of perspiration, they should always be worn loose, either as capes or cloaks, or, if they are employed in the shape of overcoats, they ought to be made very wide and provided with ventilating openings at the side under the armpits. Wet clothes and wet stockings should always be changed for dry ones as soon as the house is reached; neglect of this precaution being a fruitful cause of rheumatism and pulmonary ailments.

Bedclothes should never be too heavy nor too warm, otherwise the perspiration is interfered with, the skin is made sensitive, and the body generally becomes relaxed, the night's sleep is disturbed, and the sleeper awakes unrefreshed. Heavy cotton counterpanes are objectionable, because they weigh down the body without adding much to the warmth. All coverings of the bed, except the sheets and a light spread, should be of wool or down, when the weather and season render additional articles of bedclothing necessary. Amongst poor people, paper, whether white or brown, or even old newspapers, might be made to do excellent service in rendering bedclothes better protectors, by being stitched on to a blanket or quilt. Paper is warm and light, and on that account might be also readily utilized as a lining to coats and petticoats where economy is an object. In regard to beds themselves, spring and horse-hair mattresses are preferable in every respect to feather beds, which are excessively warm in summer, and enervating and relaxing in winter.



Especial care should be taken in regard to the clothing of infants and young children, because, as already pointed out, the system is less able during infancy to resist cold and the vicissitudes of the weather. The absurd delusion which suggests that, to harden children, it is essential to expose their little legs and chests to the piercing blasts of winter and the cold, damp winds of spring, leads to many an illness which terminates fatally. Indeed, there can be no doubt that a large proportion of lung diseases, which annually carry off so many young children, are due to needless exposure to cold, in consequence of the ignorance or neglect which prevails in the community with respect to this matter. Very young babies ought not to be taken out of doors in cold weather until they are able to walk or run about, and thus keep themselves warm by muscular exertion, as already explained, and then, as insisted on above, they should be comfortably clad. Flannel should be worn next to the skin, and neither chest, arms, nor legs ought to be exposed. Veils are sometimes useful when an infant is carried in the arms, or rides in its baby-coach, but care should be taken that they are not too thick and warm, lest they interfere with respiration and perspiration.

Elderly people, as well as young children and persons in middle life, who are delicate and apt to suffer with cold feet, should wear woollen stockings both summer and winter. Boots and shoes should be made to fit the foot easily, with low heels and fairly broad toes, and adapted to the slight natural inward curve of the right and left foot respectively. Prof. Meyer, of Zurich, was the first to point out, in his pithy little pamphlet entitled "Why the Shoe Pinches," the principles which ought to determine the shape of the shoe. These are, briefly, that the axis of the sole of the foot is a curve, and not a straight line, and that the outline of the inner side of the foot and great toe is a straight line and not a curve—both propositions being directly the reverse of the dogmas acted on by French bootmakers and their followers all over the world. Dr. Lee, of Philadelphia, justly teaches that the sole of a shoe constructed on the French pattern ought to be labeled "misery," whilst that adapted to the real curve of a healthy, undistorted pedal extremity should be endorsed with its true name of "comfort." Shoemakers, as a rule, in almost all civilized countries, even where there are none like the celebrated "Patrick O'Flanigan, French bootmaker, from Paris," pay far too little attention to the shape and action of the foot, and few of them know how to take the proper measurements. For example, the dimensions are generally taken when the foot is off the ground, whereas most of them should be taken when it is firmly planted on the floor, because it is found that, in the act of walking, the foot elongates about one-twelfth of its length, and its lateral expansion is even greater. Then, again, it is seldom the shape of the sole is noted as it should be, by drawing a pencil line around the foot when placed upon a sheet of paper. Hence it is that new boots

are such a source of pain and discomfort until the elasticity of the leather permits the boot to become moulded to the shape of the foot. High-heeled boots are a source of great discomfort, especially for ladies, in whom they not only interfere seriously with the free and healthy action of the muscles of the leg, but also, it is believed, give rise to uterine diseases of a very grave character. Tight-fitting boots and shoes induce the corns and bunions which, although they constitute some of the worst minor evils which afflict humanity, might all be avoided by proper care of the feet. For walking in wet weather, thick-soled boots and shoes should be worn, and when they become even damp they should be changed at once on returning to the house. India-rubber overshoes are very useful if worn only whilst taking exercise, but they ought to be immediately removed on coming in out of the wet; otherwise, by impeding the evaporation of the perspiration, they render the feet damp, and therefore cold. This prompt removal of overshoes, and changing of wet leather shoes or boots, is a far more important matter than is generally believed, and there are probably thousands of people who lose their lives for want of attention to the precautions urged above.

The evil results from wet feet may often be diminished, or even entirely averted, by taking off the damp shoes and stockings, rubbing the feet dry, toasting them before a hot fire or hot blast of air from a furnace, and putting on dry, well-warmed stockings and shoes, as thick as those which have been laid aside. To be successful, however, in securing good results, this programme ought to be carried out *at once*, without waiting to become rested enough after fatigue to allow of the additional exertion being made easy. Even a delay of five minutes may be sufficient to annul all benefits from such a drying process, and permit the overlong continuance of congestion in some internal organ which will lead to serious or fatal illness.

Those who suffer from tender feet should avoid wearing patent-leather boots or shoes, and should frequently change their stockings. Those, again, who have weak ankles, and persons who have to walk a great deal, will find great comfort from high laced shoes, which support the ankle-joint. Lasts made of the exact shape of the foot are exceedingly useful in preventing the many discomforts and various distortions which are often induced by badly-made boots or shoes. It seems hardly worth while to warn readers against attempting a long walk or a walking-tour with new boots on, and yet the number of pleasure-trips that have been utterly spoiled by want of attention to such precaution is almost incalculable.

Making every allowance, says Dr. Wilson, for the changes of fashion, there can be no doubt that the male attire is much more natural and healthy than the clothing worn by the other sex. The tall, stiff hat of fashionable style is no doubt a mistake, because it is too heavy and im-



pedes evaporation ; but in most other respects the garments which fashion permits to be worn by men are, as a rule, easy and graceful. But what language is strong enough to adequately condemn the tortures, discomforts, and even loss of health and impairment of vitality, to which the vagaries of fashion subject the female sex ? From childhood onward perfect freedom of bodily movement is more or less interfered with. The waist is too often pinched with corsets, which impede respiration, disturb the heart's action, and in extreme cases eventually displace the liver and other important organs of digestion. Many ladies are somehow induced to believe, or at all events act as if they believed, that a small, round waist is beautiful and attractive. But the natural waist of a well-formed woman is not round, and a small waist can only be admired when it constitutes part of a lithe and slender figure. Indeed, a waspish waist, as it is cynically termed, may betoken a good deal of physical endurance and much personal vanity, but it says very little for either the common sense or the æsthetic culture of the lady who thus sacrifices herself to fashion. The natural curve from arm-pit to hip of a handsome woman is rounded and graceful, but tight-lacing destroys this divinely-ordained balance and proportion, and makes the body as ungainly looking as an old-fashioned hour-glass. Such a distortion, however—for distortion it is—not only offends the true artistic eye, because it is ugly and unnatural, but, what is of far more importance, by it, as every physician knows only too well, healthy, active life has been heedlessly sacrificed ; and if he were allowed a voice in the matter, he would frankly and earnestly advise any one who consulted him with matrimonial views in regard to any particular female, to beware of paying addresses to a lady with an artificially-deformed waist. The chances are that such a woman will always be more or less of an invalid, and a sick wife cannot be expected to become the mother of healthy children, or, if they are born healthy, she has incapacitated herself from rearing them as they ought to be brought up.

Ladies only need to recognize and appreciate the real beauty of the natural lines of the body, and they will soon learn to regulate their own dress, and the attire of growing girls, so as to give sufficient support without causing undue constriction. The well-made corset is no doubt an improvement to the figure, but it should never be fashioned or worn so as to interfere with freedom of motion or easy carriage of the body. Fortunately, the practice of tight-lacing is not so general now as formerly, but it is still common enough to justify an earnest protest against its folly and its dangers. There is no doubt that many of its votaries would gladly leave off the practice altogether if they could, but after a time the muscles of the trunk become wasted by constriction and through want of use, so that the firm embrace of the tight-laced corset comes to be regarded as absolutely necessary for the comfort and support of the upper part of the body.



On physiological grounds, the classic mode was incomparably superior to the modern style of dress, because the whole weight of the garments was borne by the shoulders, and not from a waist constricted by bands and strings, if not by tight-laced stays. It may be true, as urged by the mantua-makers of to-day, that the style of garments worn by the Greek and Roman women is not suited to our colder climate; but the closer the adaptation of modern apparel is to that style the more artistic taste will be displayed, and the better will be the health enjoyed, whilst all other 'circumstances remain equal.

Dress should always be fashioned so as to obey the proportions of the body, and never to contradict the natural lines of the figure. Any dress or article of dress, therefore, which interferes with free movement and graceful posture is objectionable. Thus tight dresses are objectionable, because they cramp the movement of the lower limbs; long walking-dresses are objectionable, because they drag by their weight, so as to cause oftentimes dangerous pressure upon important organs, and besides the skirts often become wet and dirty; garters worn either above or below the knee at all tightly are objectionable, because they impede the free circulation of the blood, and are apt to induce varicose veins; low bodices are objectionable artistically, because they detract from the height, and, from a health point of view, they are still more inadmissible, because many young girls, and old ones too, suffer seriously from such exposure of the upper portion of the chest during cold weather. All these points should be considered and allowed to modify attire, to some extent at least, no matter what may be the prevailing fashion. The present close-fitting dresses, provided they are not made too tight, are to be commended, on account of their being in accordance with the natural outlines of the body, and they are certainly well calculated to display the beautiful proportions of a well-made figure. But they tempt those who are inclined to be a little too stout to brace themselves up in every way too tightly, and those who are somewhat thin and angular to resort to padding and other harmful devices.

Whilst most female readers of these pages will no doubt continue to dress according to the custom of the day, in the devout belief that they might as well be out of the world as out of the fashion, yet it is hoped that these sanitary hints in regard to apparel, from a hygienic point of view, may lead to such moderate modifications of each prevailing mode, as it swiftly passes over the feminine world, as will contribute to the preservation of health in no inconsiderable degree.

#### **Poisonous Clothing.**

In connection with the subject of clothing, it should be mentioned that articles tinged with certain of the brilliant aniline dyes, now so much in vogue, are sometimes very dangerous to health. The bright-colored

stockings, and in particular those dyed with red, purple, blue, and green tints, are especially apt to be injurious. Certain of the other articles of underclothing, similarly colored, have likewise unfavorably affected people who indulge themselves in such gaudy attire, and the author of this work once attended a severe attack of poisoning of the neck and face from a crimson neck-handkerchief dyed with aniline. Persons are not generally affected by these arsenical dyes in clothing unless they have very sensitive skins, or the amount of the coloring matter in the fabric is unusually large, but it is far safer not to wear any gloves, stockings, or underclothes of these brilliant hues until after they have been thoroughly washed. Should, however, the attraction to one's vanity of appearing thus brilliantly adorned prove too strong for prudence to overcome, the danger to health may be diminished, or perhaps annulled, by wearing plain cotton or linen underneath the ornamental articles. The cases of poisoning are only those of the cutaneous surface, and usually not dangerous to life, although the itching and intense heat are so distressing that people rarely violate the laws of hygiene in this respect a second time.

### **Local Injuries from Cold.**

Cold in its minor degrees gives rise to the painful affections frost-bite and chilblains, the former involving the nose, ears, and fingers, and the latter the feet. When locally applied to a larger extent of surface, it may produce mortification of the feet, requiring amputation. Very often this mortification of the ears, nose, or lower extremities is largely due to the ignorance of those who, with the best intentions in the world, attempt to succor unfortunates who have been affected by severe cold. Every one should be taught that to apply hot water, or use heat in any way, on a frost-bitten part, is to cause intense pain to the patient, and to seriously imperil the portion of the body involved. The real object is to prevent too rapid reaction, and the application of cold of less intensity is the only relief. The first thing to do with numb or frozen fingers is to plunge them either into snow or into the coldest water obtainable, or, if the part cannot be immersed in water, and no snow is at hand, cloths wet in very cold water may be used to rub the affected portion, only moderate friction being employed. If snow is obtainable, the best thing is to rub the affected part with it until circulation begins to be re-established and sensation returns to some extent. All this should be done in a cold room, for as soon as the frost-bitten member feels the warmth of the house, suffering begins. If properly remedied in this way as quickly as possible, the local effect of intense cold is not necessarily to destroy the life of the part affected, as is shown by the numerous successful applications of what is called local anaesthesia, for the painless opening of boils, felon, and other small abscesses. In this valuable method for relieving the pain of many minor surgical operations, the skin and a layer of the subcutaneous tissue



is frozen by the aid of ether spray, or by a freezing mixture, which seldom produces any mortification of the part afterwards; if long continued, however, such a result would almost inevitably follow. The local application of cold to an important organ may destroy life, as is sometimes seen in the fatal prostration resulting from filling the stomach with very cold water whilst the body is hot and perspiring.

Since heat has a depressing and cold a debilitating effect upon the human system, it is obvious that rapidly alternating vicissitudes of heat and cold are more injurious than the steady prevalence of cold alone, unless this is of great intensity. This is especially the case because even a moderately low temperature, operating during the relaxation which follows heat, has a much greater effect than if there had been no such contrast.

When persons are frozen to death, the fatal result occurs in consequence of the depressing effect of the cold long before actual congelation of the body takes place; the mechanism of this depression being probably that the blood, which is chilled in circulating feebly through the partly frozen hands and feet, no longer stimulates the heart and the brain to do their duty, as it should and would do if warmed to the natural standard. Of course, with the failure of the heart's action, and of the respiration, in consequence of the stupefied brain no longer feeling the need of fresh air, death is the inevitable result.

### **Light and Electricity in their Sanitary Relations.**

Light has a powerful general action upon the systems of both man and the inferior animals, not only through the blood, but also through the nervous apparatus. It has a direct local effect upon the organs of vision, to which it is the natural excitant, and upon the skin, in which it produces the varieties of coloration. Light comes to us from two sources—first, from the sun, when it is called natural light; and second, from some terrestrial body, in combustion or incandescence, when it is denominated artificial light. In regard to the influence of light as a contributor to health, the Italians have an excellent proverb, which says, "Where the light does not enter, there sickness goes in." The fact is, that the general effect of sunshine is just as important to the perfection of development and of function, as the influence which results from pure air is necessary for the production of rich blood and the completion of nutrition. The activity of light in promoting the vigorous development and growth of plants, as it does also those of animals, is obviously seen by comparing the strong, dark-colored stems of a potato-vine grown in an open field with the thin, pale, and weak shoots which are put forth from potatoes in a dark cellar. This process of blanching, or etiolation, as it is called, is often seen in men, such as miners, who lead underground lives, and especially in children who feebly exist in dark, narrow courts and alleys,



likewise in infants belonging to a wealthier class, who, through mistaken caution, are too closely confined to the house. In such cases, the skin is decolorized, becoming of a dead white hue, the common term of "putty-faced" being singularly expressive of the countenances of children suffering, as so many do in cities, from privation of the sun's rays. This pallor indicates a serious loss of vitality in the skin, an organ which, as stated in a previous chapter, is very precious to the maintenance of health, and especially so to a young child. Under natural conditions, the skin absorbs a certain amount of oxygen, and gets rid of about half as much water and one-fortieth as much carbonic acid as is thrown off from the lungs; but if the cutaneous surface is not exposed to the light, the first and last of these processes are sadly interfered with, and a greater amount of work is either thrown upon the lungs or purification of the blood is incompletely accomplished.

The pallor of the skin observable in an individual shut off from access of sunshine is only an index of what goes on in other tissues of the body, particularly in the blood, the red globules of which rapidly diminish in number. The connective tissues, just beneath the skin, not getting rid of their contained fluids as they should do, through the cutaneous surface, become swollen, and, as it were, sodden with an excess of serum, not unlike an imperfect form of dropsical effusion. All the functions of the body participate in the partial stagnation of the operations of the integument, and little by little, if deprivation of sunlight is continued, vitality diminishes throughout the whole system. This condition has been aptly styled "physiological destitution," and in it we see the bones of infants become bent, the teeth tardily and imperfectly developed, the lymphatic temperament appears in an exaggerated form, and rickets or general scrofula is often the result. In certain of the Alpine valleys, which are so deep that they receive the sun's rays but a small part of each day, even in summer, the inhabitants are especially apt to suffer from the sort of mental incapacity called cretinism, doubtless due to incomplete development of the brain from privation of light, at least in great measure.

Not only are animals, deprived of the vivifying influence of sunlight, blanched and stunted in this way, but their very development is checked, or even prevented. One of the most singular instances of the evil effects of privation of light is seen in the remarkable eyeless fish of the Mammoth Cave in Kentucky. In these fishes, which, owing to their peculiar circumstances, are never exposed to the faintest ray of light, the eyes are entirely absent, and it would seem that, in the curious economy of nature's wonderful processes, the organs of vision, being no longer of any use to the creature, have been entirely omitted from its modified plan of development—modified in exact accordance with the unusual circumstances which surround it. The influence of light upon higher animals is also well marked, and it may generally be observed that

those parts of the bodies of land animals nearest the ground, and consequently most deprived of the direct rays of sunlight, are white or light-colored. The brilliant hues which are found upon plants and animals of nearly every kind in the tropics are probably due, at least in part, to the superabundance of light with which these regions are flooded. Many years since, Dr. Edwards performed some very curious experiments upon tadpoles enclosed in dark boxes, which showed that the access of light was highly important in promoting their development into perfect frogs. He found that, out of twelve tadpoles enclosed in a tin box pierced with small holes and sunk several feet into the Seine, only two were developed into frogs, the other ten remaining in the tadpole condition. In some of these instances it did not appear that growth was prevented, as the tadpoles continued to increase in size, but their natural development into a higher and more specialized form of the animal creation was stopped. Dr. Hammond reports that he has several times repeated these experiments, and always with similar results. On one occasion he prevented for one hundred and twenty-five days the development of a tadpole, by confining it in a vessel to which the rays of light had no access; and yet, on placing it in a receptacle open to the light, the transformation into a frog was at once commenced, and was completed in fifteen days. If every parent and teacher having charge of young and growing children would try this little experiment for himself, and see with his own eyes how the development of these inferior creatures is repressed by the want of light, we might hope that many of the dark nurseries and school-rooms in which unfortunate little ones have their growth stunted, and their physical and intellectual development checked, would be done away with, and the evils of want of light, from which so many young children suffer, vastly diminished.

If we study the deterioration which occurs in etiolation, brought on by privation of light, a little more in detail, we will find it presents the following characters: First, the diminution of the red blood corpuscles, which fall from the usual average of five millions in each cubic millimeter, or drop of the vital fluid about one twenty-fifth of an inch in diameter, to two or even one and a half millions, accounts for the bleached hue of the whole body, and explains the bellows-murmurs heard in the heart, and the venous hum in the larger veins which soon become manifest. Second, the diminution of the albumen of the blood-serum accounts for the tendency to dropsy about the ankles and beneath the eyes, and later for the general dropsy, which is so generally met with. Third, decrease in the proportion of fibrin is much less frequent, and only takes place, as a rule, when the privation of light is complete and prolonged, as in the cases of miners continuously employed in deep pits, or prisoners purposely confined in underground dungeons, such as one sees in the Tower of London, or the torture-chambers of Antwerp, and the Spanish Inquisi-



tion. When marked diminution of fibrin does occur, the production of hemorrhages and of purpura is the consequence. As a further result of these alterations of the constitution of the blood, we observe, if the deprivation of light continues, there are set up grave and fatal organic maladies, such as scrofula, tuberculosis, and their consequences. A well-known illustration of this tendency is met with in the stall-fed cattle, kept largely upon swill in the underground stables of large cities, since they generally perish in a few years from well-defined consumption, resulting from the combined evil effect of deprivation of light, air, and exercise.

### **Injuries to the Eyes from Excess or Deficiency of Light.**

The most important local affection brought on by deprivation of light, is that which makes its appearance in the organs of vision. With some individuals, the eyes gradually become accustomed to the feebleness of illumination, being rendered keener and more capable of recognizing objects in obscurity, thus approximating to the powers of owls, bats, and other nocturnal animals. In a majority of persons, however, the eyes are rendered so sensitive that they become incapable of supporting the mid-day sunshine, or sometimes even ordinary diffused daylight, without distress or injury. Occasionally the privation of light itself is sufficient to bring on various troubles of the organs of vision, for instance, a sensation of great fatigue, followed by more or less complete failure of sight.

From a hygienic point of view, it is a great mistake to construct almshouses, prisons, and so forth, in such a way that the inmates will suffer from a deficiency of light, and the arguments of mistaken economy or avarice may be overcome by the proof which statistics readily furnish of the greater expense for sickness and ill-health, which result from want of proper sanitary precautions in this respect.

Since darkness is a much more powerful influence towards injuring the human system, if it is conjoined with cold and wet, it is very important for workmen in mines to wear warm clothing, and to avoid moisture as far as possible. A method adopted in some countries of having the miners divided into two gangs, which labor alternate weeks upon the surface of the earth and in the subterranean galleries, affords apparently excellent results.

The effect of superabundant solar light upon the human body can scarcely be separated from that of excessive heat. Its action, when less intense than that before referred to as productive of positive disease, and longer continued, is to increase the amount of the coloring matter of the skin, and to render the integument much darker. The influence of too strong a light upon the organs of vision is sometimes to bring on inflammation of the eyes, blindness from injury to the optic nerve, and, indirectly, disorder of the brain. The case of a child is reported who was rendered permanently blind by looking intently at a bright object while



she was having her photograph taken, and temporary, or even lasting, blindness from gazing at a brilliant flash of lightning has not unfrequently been produced. The amount of effect produced by intense light of different colors varies, however, considerably. Blue and green have a much less injurious action than yellow, orange, or red; but white light is the most obnoxious of all to the organs of vision, and hence white objects, when intensely illuminated, have a highly injurious effect. The painful consequences of bright sunlight reflected from snow in the Polar regions, or on the tops of high mountains, from white sand on the seashore, or even from white-washed walls on sunshiny days, are well known.

Prof. Charcot has demonstrated that a powerful electric light, besides its unfavorable action upon the sight, with which most persons are now familiar, can also give rise to a cutaneous irritation called erythema, and very similar to sunburn. He attributes this effect to the chemical rays, the same which have enabled photographers to take some excellent pictures by the electric light in the entire absence of sunshine.

The prevention of inflammation of the eyes, nervous blindness, and other ocular affections, arising from excess of light, is very simple. It consists in the use of dark-green, blue, or smoked-glass spectacles, or where these cannot be procured, the employment of pasteboard, wooden, or leather coverings for the eyes, each furnished with a very narrow slit, permitting vision, but cutting off the superabundance of light. These appliances are very efficacious and satisfactory when properly used, but neglect to avail oneself of them from the very moment of commencing exposure to excessive illumination, will sometimes counteract all their benefit.

It is now claimed that, in consequence of recent improvements in the electric light, and the reduction of its brilliancy at will, it is absolutely without danger to the organs of vision, and that, from a sanitary point of view, it deserves great preference over the older methods of lighting, because, first, it does not pollute the air with dangerous gases; and second, it produces a greater visual unity than with day-light or gas-light. It is probable that the hygienic qualities of the electric light have not yet been appreciated at their full value.

### Electricity as a Cause of Disturbance to Health.

The influence of electrical states of the atmosphere upon the human system can scarcely be disputed, although it is by no means fully understood how the effects are produced. A knowledge of its application in the treatment of disease has been very much advanced of late years, and great success has attended its employment as a remedy in suitable cases; but we are still largely ignorant of the part played by this powerful physical agent in the production of disease and the preservation of health. The elevation of spirits and feeling of strength and vigor commonly

experienced in cold and so-called bracing weather have been attributed to a highly electrical condition of the atmosphere; and the depression of mind and generally uncomfortable sensations which most people suffer from on damp, gloomy days, when the electrical tension of the air is unusually low, has likewise been assigned to that want of this invigorating agent. Writers upon medical electricity state that, on the approach of a thunderstorm, difficulty of breathing, due to heart-disease or distension of the air-vesicles of the lungs, often grows worse; patients suffering with chronic rheumatism and neuralgia complain of an increase of pain; the chills of fever and ague anticipate their usual time of occurrence; that the symptoms manifested in many acute maladies, such as inflammation of the lungs, become more alarming, and that where death is impending, it is apt to come sooner in stormy weather than would otherwise be the case. We cannot as yet, however, admit as proved that electrical conditions, by themselves, thus modify the phenomena of disease. In regard to neuralgia, however, the observations of Dr. S. Weir Mitchell, of Philadelphia, appear to show that, outside of the area of low barometer, the course of which across the country is that of a storm-track, as explained on page 116, travels a belt of atmospheric disturbance, probably electrical in its character, some one hundred or one hundred and fifty miles wide, which acts as an exciting cause of neuralgia in persons who are predisposed to such attacks. Dr. Mitchell says that the rain usually precedes the storm-centre five or six hundred miles, but before and around the rain lies a belt, which may be called the neuralgic margin of the storm, and precedes the rain about one hundred and fifty miles. This fact is very deceptive, because the sufferer from neuralgia may be upon the far edge of the storm-basin of barometric depression, and see nothing of the rain, yet be called upon to endure the pain due to the storm. It is interesting to figure in one's imagination this moving area of rain, girdled by an immense neuralgic belt a hundred and fifty miles wide, within the area of which, as it sweeps along, in advance and at the side of the storm, prevail in the hurt and maimed limbs of men, and in tender nerves and rheumatic joints, renewed torments called into existence by the stir and perturbation of the elements.

The sanitary precautions suggested by the results of the curious and interesting investigations of Dr. Mitchell, are obviously the careful avoidance of the local co-operating causes of neuralgic and rheumatic attacks, such as damp clothing, exposure to draughts of air, and so forth, about the time that the Signal Office reports give warning that a wave of the general exciting cause of this kind of suffering is on its way to any particular invalid.

Since electricity has almost certainly the power, in some instances, of aggravating an existing malady, the question has often been asked, Whether it possesses the capacity of originating any disease to such an



extent that a storm may be the starting-point of an epidemic? It is reported that an epidemic of cholera broke out in Toulon in 1866, immediately after a violent tempest, which seemed to mark its onset; and that, in Rio Janeiro, an epidemic of yellow fever has been known to redouble its intensity directly after a severe storm. A similar event is stated to have occurred in a town on the Mississippi river during the bad pestilence of yellow fever, which visited this country in 1878. Epidemics of influenza are often markedly associated with the advent of tempests in their appearance in particular communities; and the same fact has been noticed in regard to the development of disease of the lower animals. On the other hand, these alterations in the atmospherical electricity, or at least the perturbations in the air which give rise to them, sometimes seem to put an end to prevailing epidemics.

Upon the theory that feelings of both mental and physical prostration are sometimes due to a diminution of the electrical tension in the human system, attempts have been made to treat general debility by artificially supplying this deficient element. According to advocates of this method, the results have been so gratifying as to be worthy of far more attention than the agent as a remedy has hitherto received.

#### **Protection Against Lightning-Stroke.**

The means of avoiding serious injury to health, or actual destruction to life, from the electric spark, upon the prodigious scale in which it is displayed by nature in thunder-storms, obviously form a department of preventive medicine, and should be referred to in this chapter. Much attention is paid to this subject by the French sanitarians, even in the elementary works upon hygiene which have of late been introduced by law into the public schools. The rules for escaping lightning-stroke, promulgated by our venerated townsman, Dr. Benjamin Franklin, are still quoted with high approval; and indeed, such honors seem by no means ill-deserved, when we reflect that the kite-string in Franklin's memorable experiment in a field, as it was then, near the present magnificent City Hall of Philadelphia, has become the progenitor, as it were, not only of the millions of lightning-rods which protect dwellings in every part of the civilized world, but also of the marvellous network of telegraph-wires and ocean cables, which during the last half century have so wonderfully modified the social and mercantile life of the human family.

The electricity of the atmosphere is the result of physical causes, such as the movement and pressure of the air, friction against the earth, differences in temperature, and chemical reactions. Some meteorologists contend that the earth is charged with negative and celestial space with positive electricity. At all events, there is no doubt that lightning is the electric spark, upon a very large scale, passing from one cloud to another, or from



a cloud to the earth, and temporarily or partially restoring the disturbed equilibrium of electrical tension.

According to Arago, fewer persons are struck by lightning than is generally supposed. It is stated that, in Paris, there has been no fatal stroke of lightning for a great number of years; but in Göttingen, five deaths are reported in the last half century. It is to be observed, however, that these cases are much less frequent in cities and towns than in the open country. Tall trees, bell-towers, houses situated upon mountains and high hills, and, as a consequence, the inhabitants of these dwellings are especially liable to be struck by lightning.

The effects of a thunderbolt are very variable. Sometimes, when a person is directly in the course of the discharge of electricity, death takes place instantaneously, and without any apparent wound. In other cases, when individuals happen to be situated at the side of the bolt, as it were, they may nevertheless experience more or less serious injuries, occasionally fatal in their character. Lightning not infrequently produces burns, which may be quite extensive, or it may leave its victim suffering from paralysis of one side of the body, paralysis of a single limb, or from blindness, these affections being generally incurable. It sometimes happens that a thunderbolt will tear and burn the clothing of an individual, and overturn various surrounding objects, without doing him any personal harm, or with this disturbance of circumjacent bodies, he may be struck with a fainting-fit, fatal or only momentary. Death in these instances may be due to some ill-understood disturbance of the brain, to the syncope or fit of fainting, to asphyxia, or to the effect of the burns and wounds. Post-mortem examination discloses no characteristic changes, although congestion of the heart, lungs, and brain is usually found, and the blood is apt to be uncoagulated.

The great means of protecting houses and their inhabitants from the evil effects of a stroke of lightning is, of course, a well constructed lightning-rod. When properly arranged, a rod generally secures objects situated within a circle, the diameter of which is four times the height of the point of the rod above the plane in which they are placed. The lightning-rod should be at least three-fourths of an inch thick, insulated by broad glass supports, well pointed at its upper end with platinum or gold, and have its lower extremity embedded in moist earth to the depth of six or eight feet. Everybody should be taught that they ought not to take refuge under high trees, or lower trees upon elevated ground, during thunderstorms.

It is found that large groups of men or animals seem to attract the lightning, and this is explained on the theory that the elimination of warm moisture from the lungs and skin of so many individuals produces an ascending column of vapor, which conducts the flash of electricity downward to the earth. Hay- and grain-stacks, manure-heaps, and so forth,

probably have the same effect, and proximity to them should similarly be avoided during thunder-storms.

Arago states that when a stroke of lightning falls upon several animals or men who happen to be in a line, those at the two extremities of the row feel the most injurious effects. It is popularly supposed that people who ride or run rapidly through a thunder-storm, and those who stand by open windows to watch the lightning, are particularly apt to suffer from its effects.

It can hardly be doubted that silk clothing helps to preserve the wearer from a lightning-stroke. Prof. Gavarret instances the following occurrence: "The day when a thunderbolt fell upon the church of Lez-Moustiers, three priests were officiating at the altar; two were severely hurt, whilst the third suffered no injury, and he alone was attired in vestments of silk."

Prof. Becquerel gives Dr. Franklin's five rules for avoiding being struck by lightning, as follows: First, always avoid the neighborhood of chimneys, because the soot which lines them is, like metals, a good conductor of electricity. Second, it is well for the same reason to keep at a distance from metallic objects generally, and to lay aside gold or silver chains, ornaments, coins, etc., during a thunder-storm. Third, never place yourself under a lamp, a bronze or other ornament of metal, a tree, or any high object whatsoever, when you have reason to fear a lightning-stroke. Fourth, it is well to put between oneself and the earth a non-conducting substance, such as a thick plate of glass, for example. Fifth, the less an individual touches the walls and the floor of a house, the less he is exposed to being struck by lightning. Hence, the safest preservative means would be to occupy during thunder-storms a hammock suspended by silken cords in the middle of a large apartment. This last suggestion would, of course, chiefly benefit timid hysterical females, to some of whom, however, it would fully repay all the trouble involved in putting it into practice, by relieving that agonizing fear of being struck by lightning, which, we may assure them, is totally needless when they adopt such a sure precaution against the dangers of atmospheric electricity.

### Climate and Soil in their Relations to Disease.

Few intelligent persons can be found to doubt the importance of climate as a promoter of health and of disease, and perhaps one of the commonest popular explanations of sickness, in persons newly arrived in any particular place, is that the climate does not agree with them.

As Baron Humboldt observes in his *Cosmos*, if the surface of the earth consisted of one and the same homogeneous fluid mass, or of strata of rock having the same density, smoothness, color, and power of absorbing heat from the solar rays and of radiating it in a similar manner through the atmosphere, the lines of equal average temperature for summer, for

winter, and for the whole year would all be parallel to the equator. In this imaginary condition of the earth's surface, the power of absorbing and emitting heat would everywhere be the same in the same latitudes. But as such a condition of affairs does not exist in nature, a wide diversity in the temperature, moisture, and quantity of rain is met with at places equidistant from the equator, and therefore extremely different climates are possessed by countries having precisely the same latitude. Dr. Hammond remarks that the climate of the United States is colder than that of European regions of the same latitude, but warmer than places similarly situated in Asia. Thus, the fortieth parallel of north latitude runs through Philadelphia, and the forty-first runs a few miles north of Naples. The average temperature of the former place is only about fifty-four and a half degrees, whilst that of the latter city is sixty-two degrees. The fortieth parallel also passes through Pekin, but there the mean annual temperature is only about fifty-two. Across our continent of America there is likewise a good deal of variation in temperature of places in the same latitude. Thus, for example, the line drawn upon a map of the United States through the places where weather reports show the mean annual temperature is fifty-one degrees, or, as it is called in climatology, the "isothermic line of fifty-one," enters our Pacific coast high up near Vancouver's Island, on the border of British America, traverses the continent in an irregular diagonal towards the Mississippi river near St. Louis, passes almost through New York City, curves upward again towards the Arctic circle in the Atlantic, in consequence of the Gulf Stream, descends in Great Britain so as to pass nearly through London, traverses Russia near Odessa, China near Pekin, and Japan near Kanagawa. As a general result of the investigations upon which are founded these isothermic charts, as maps exhibiting the isothermal lines are usually called, it appears that, in the northern hemisphere, the eastern side of the continent is the colder and the western warmer, although a few exceptions are met with to this usual rule.

But it is not alone in temperature that climates differ from each other, and are endowed with the power to check those early manifestations of oncoming disease, which in many maladies are alone, or chiefly, as in consumption, in our hands to control. Into our complex idea of climate considerations as to the humidity of the air, as well as its temperature, the amount of rainfall, the frequency of tempests, fogs, and dew, and the direction and force of the prevailing winds, must enter. Most of these points have already been discussed in the chapter on Air in its Hygienic Relations, and need not now occupy our attention. (See page 118.)



### Diseases Benefited by Change of Climate.

Among the diseases in which alleviation or cure may be expected, from the favorable effects of change of climate, may be mentioned pulmonary consumption in its earlier stages, chronic bronchial affections and diseases of the throat, asthma, chronic gout and rheumatism, dyspepsia, affections of the kidneys, and especially Bright's disease, and obstinate neuralgia. Besides these particular maladies, change of air and scene is useful to delicate, scrofulous children; it is invaluable as a restorative during convalescence from either acute or chronic disorders, and, above all, it is one of the chief resources of preventive medicine generally. In incurable maladies, visits to other parts of a patient's country, or to some foreign land, will now and then serve to ward off complications, exhilarate the spirits, promote appetite and digestion, and be the source of tranquil slumbers.

As advantages and disadvantages are to be found in every climate, it is always a balance of probabilities, which must be determined in any particular case, when either the removal from an unfavorable situation or the selection of a more beneficial locality is the question at issue. Such judgment in regard to a particular place can only be correctly made by procuring authoritative reports, such, for example, as those of the Signal Service, as respects the average and extreme temperatures, humidity, rainfall, and so forth. Besides the comparatively invariable characteristics of this kind, temporary drawbacks, like local epidemics, contagious diseases, prevailing dampness or dryness of the season, should all be carefully inquired into and considered.

The advantages of a climate where sea-air is abundant are the relatively slight variations of temperature and pressure of the air, with the presence of iodine and of ozone in comparatively large quantities. Ozone appears to act as a stimulant to a high degree upon most of the vital functions of the human system, and this stimulation may go so far as to prove positively injurious, especially in diseases of the lungs. Patients with chronic consumption are often found to be benefited by a sojourn of one, two, or three days at the seashore, but to experience, if their visits are further prolonged, a general feverishness, accompanied by a sensation of tension or constriction about the chest and throat, which is liable to culminate in an actual attack of spitting of blood. Other cases, where consumption occurs in persons of less excitable temperament, are able to endure the exciting effects of the ozone without injury, and derive, on the contrary, great benefit from the stimulating action of the sea-air. The climate of mountainous regions enjoys the advantage of a generally pure air of average low temperature, supplied with an abundance of ozone. As a rule, the mountain-air has a tonic and bracing effect, sharpens the appetite, relieves the constipation, and tends to overcome a disposition toward impoverishment of the blood.

Some of the relations to human maladies of the meteorological conditions found in different climates, and especially the relations to epidemics, depend no doubt upon the influence which these conditions exert, directly or indirectly, upon the growth and development of the lower organisms, in accordance with the germ-theory of disease, to be more fully explained in the next chapter upon contagion. An example of direct influence may be cited in the striking effects of cold upon yellow fever, a single sharp frosty night sometimes putting an abrupt end to an epidemic. As specimens of indirect influence, may be instanced the increase of small-pox and typhus fever in cold weather, due to the overcrowding of the poor, for the sake of warmth, in the more northern climates; or the frequent outbreaks of typhoid fever, and of cholera, after heavy falls of rain, attributable to the washing of the infectious particles of typhoid or choleraic excrement into the sources of water-supply. Temperature and light, which are such important elements in the constitution of any climate, have a powerful influence upon the growth of the lower organisms generally, and each peculiar organism may require a special temperature, which often possesses very narrow limits only. Thus, for example, Dr. Koch states that the bacillus believed to be the cause of consumption will not propagate below temperatures of  $86^{\circ}$  F., and therefore it must gain access to the interior of a warm-blooded animal before it can multiply itself, except, perhaps, in very hot climates.

The instruments used to observe accurately the physical conditions and changes which make up the climate of any particular locality, comprise the following: For determining variations of temperature, ordinary thermometers are too well known to need description. Maximum and minimum thermometers, or self-registering thermometers, differ simply in having arranged in their tubes little cylinders of glass or porcelain, which are left behind when the mercury retires from its highest point, or rises from its lowest point, during a given observation. Humboldt's rule for determining the average temperature of the day was to observe the thermometer at the moment of sunset, and this would answer very well, except within the polar circle, where the sun does not set sometimes for several weeks. In the United States, the hottest part is found to be the southern extremity of Florida, and next rank southern Texas and southwestern Arizona. The coldest climates, except of course Alaska, are those of northern New England, Michigan, Wisconsin, and Minnesota. The heat of any particular place is much affected by altitude above the sea-level, and, as a general rule, every three hundred feet of ascent make a difference of one degree in lowering the temperature.

Climates are also divided into moist and dry, according as the amount of watery vapor in the air is comparatively large or small. Air of different temperatures takes up very varying amounts of water, and hence, if warm air nearly saturated with moisture is cooled a little, the water is



deposited upon metallic and other cold objects. The amount of water dissolved in the air is called its relative humidity, and it is usually expressed as a percentage of all the water which could possibly be dissolved in air of that particular temperature. The most agreeable and healthful quantity of moisture in the air is from sixty to seventy parts in the hundred—that is to say, a relative humidity of sixty or seventy per cent.; but on foggy mornings we are often obliged to encounter an atmosphere which is not only saturated, but over-charged with watery vapor. This moisture being beyond the power of the cool morning air to dissolve, is precipitated or held suspended in the form of the minute, watery drops of mist. Often, as the atmosphere is warmed by the sun's rays, and its capacity for taking up moisture is thereby increased, the mists are entirely re-dissolved. The simplest method of determining whether air is very moist, or, as it is also called, has a high dew-point, is, as already intimated, by observing how quickly a goblet of cold water becomes clouded on its outside with condensed watery vapor or dew from the air, cooled by contact with its external surface. For accurate observations, however, wet- and dry-bulb thermometers, corrected by the aid of Glashier's elaborate tables, are required. Climates must also be considered in connection with the pressure of the air, as dependent upon its own altitude above the surface of the earth. Alterations in this are measured by the barometer, of which the cheapest and most convenient form is the aneroid barometer. The modifications observed on ascending upward from the level of the sea are, first, rarefaction of the air, the result of diminished height, and, of course, decreased weight of the superincumbent column of the atmosphere. The first nine hundred feet take off about half a pound of the fifteen pounds to the square inch with which the atmosphere presses upon us at the sea-level; second, we notice a lower temperature, and above the altitude of four thousand feet lessened moisture; third, greater movement of the air, increased amount of light, and greater freedom of the atmosphere from the germs of vegetable and animal organisms. Owing to the rarefaction and lessened humidity of the air, the soil is more rapidly heated during the day, and cools more quickly at night. The effects of lessened atmospheric pressure begin to be perceptible upon the human organism at the altitude of about three thousand feet, in quickened pulse and respiration, the former rising fifteen beats, and the latter ten or fifteen inspirations, above the natural rate. There is also increased evaporation from the skin and lungs, and, as a consequence, diminished bulk of the renal secretion. Travellers and aeronauts tell us that at great heights they experience outward pressure of the gases of the body, swelling of the superficial vessels, and not infrequently bleeding from the nose, eyes, ears, and lungs. At more moderate altitudes, of say six thousand feet, however, the effect of mountain-air is to produce, or at least to aid other causes in producing, marked improvement in



digestion, blood-formation, and nervous and muscular energy. The diminution of oxygen in the rarefied air is precisely in proportion to the pressure removed, and it is believed that the quickening of the respiration, noticed in ascending heights or in a balloon, occurs to compensate for the smaller amount of oxygen in the inspired air at high altitudes above the sea-level. As a curative agent, air of lessened pressure, such as is found in high altitudes, is very useful in all conditions of the system where the blood is impoverished, whether these states be the result of malaria, loss of blood, digestive debility, or from poisoning by mercury or lead. On the other hand, it is probable that pneumonia, pleurisy, and acute bronchitis are more apt to occur in visitors to high altitudes than at the level of the sea. Whenever there is a fullness, as in plethora, or when any excitement of the action of the heart increasing the vascular tension exists, the diminished pressure of elevated climates favors bleeding from the mucous membranes, such as that of the throat and lungs. Thus it is said that new-comers in the high table-lands of Colorado may be recognized by the spots of blood upon their handkerchiefs.

The effects of increase of pressure of the atmosphere, such as would be found in very low-lying valleys, have been studied in persons working in mines, in diving-bells, and in patients submitted to treatment by compressed air. The result of doubling the pressure is to render the pulse and respiration slower, to increase the amount of secretion from the kidneys, probably to diminish the amount of evaporation from the lungs and skin, and sometimes to bring on ringing and pain in the ears.

In estimating the relative advantages of different climates for the residence of a particular invalid, it is moreover important to obtain information as to the amount of rain, the rapidity of evaporation of water from marshes, lakes, and rivers, the force and direction of prevailing winds, and the constituents, chemical or otherwise, of the atmosphere. Rain-gauges for determining the amount of rainfall, the depth of which is usually recorded in inches and hundredths of an inch, are supplied of various forms and patterns. One of the simplest is that consisting of a conical cast-iron vessel, in which the depth of contained water after a storm is measured by dipping into it a brass scale, graduated so as to indicate hundredths of an inch. Snow is to be melted and reported as rain, and the signal office directions are, that when this cannot be done the depth of snow shall be taken, and ten inches of it estimated as representing one inch of rain.

The direction and power of the prevailing winds at a summer, and especially at a winter, resort, should be carefully investigated when endeavoring to decide as to its eligibility for a particular case of disease; but these have already been discussed in the chapter on Air.

### Soils in their Hygienic Aspects.

In considering the subject of soils as affecting health, it is necessary to examine and estimate the influence of mineral, animal, and vegetable matter in the soil, and also the air and water, which interchangeably occupy its interstices. The amount of air in the soil is much greater than is generally imagined, and only the hardest rocks are free from it; soft sandstones may contain from twenty to forty per cent., and ordinary clay or loam, when perfectly dry, may hold in its cavities as much as seventy per cent. of its bulk. The air in the soil, or ground air, as it is called, is mostly rich in carbonic acid and in moisture, and besides is often loaded with animal effluvia and other organic substances. (See page 131.)

The subterraneous atmosphere thus existing in dry soils is in continual movement, the chief causes of which are the daily changes of surface temperature, and particularly the fall of rain, which rapidly displaces the air from the superficial layers; and later, as it soaks down to the level where the earth is constantly saturated, that is, to the level of the ground-water, must necessarily, by raising this level, throw out a proportionate quantity of air from the soil.

The proverbial unhealthiness of dwellings built upon made ground, that is, soil which is filled in for the purpose, at least for some years after the earth, ashes, and so forth, have been artificially deposited, is doubtless due to the rising up of vitiated air from the impure and decomposing matters in the soil into the warm houses above. To prevent this as much as possible, the basement of the habitation should always be paved or laid in concrete. The paving of streets in towns has often been found to effect a marked increase in their salubrity, probably because the stones or bricks hinder, to some extent, the escape of noxious effluvia into the air. As a rule, loose porous soils, unless they emit injurious elements from animal or vegetable decomposition, are favorable to health, but even on such soils many cases of malarious influence occur, and it is always advisable to avoid the entrance of air from the subsoil into houses as far as possible. The most important diseases which have been attributed to effluvia from the soil are cholera, typhoid fever, yellow fever, intermittent and remittent fevers, and dysentery.

The ground-water, as previously explained, is the sheet of thick mud which in all places, except where the bed-rock comes to the surface, underlies the crust of the earth, and marks the level of the water in wells. Its upper margin is reached when people dig down to water, and it sometimes lies only a few feet below the surface, at others as far down as three hundred feet. The amount of mere moisture present in the soil, above the level of the ground-water, depends upon the power of the soil to absorb water from the latter source, and also upon its capacity to retain the rain-water as it trickles through from the surface of the earth. The

effect of a fall of rain in raising the level of the ground-water is sometimes only exhibited at considerable distances, and after an interval of weeks or even months. The pressure of water in the river Rhine has been shown, by German observers, to affect the depth of water in a well over sixteen hundred feet away.

### Diseases Dependent upon Soil.

In regard to the diseases connected with moisture and ground-water in the soil, the dampness of the earth may presumably affect the health in two ways, first, by the effect of the water in itself causing a cold soil, a misty air, and a tendency in persons living on such a soil to rheumatism and catarrhal attacks; and, secondly, by aiding the evolution of organic emanations. The decomposition which goes on in a soil is owing to four conditions, namely, the presence of decomposable organic materials, which may be either animal or vegetable, heat, air, and moisture. These emanations are at present chiefly known to us by their effects, although, according to the germ-theory of disease, they are probably low forms of life, which grow and propagate under these conditions; at any rate, moisture seems to be an essential element in their production. The ground-water is supposed to affect health by rendering the soil above it moist, either by evaporation or capillary attraction or by alternate wettings and dryings. It is a matter of personal experience with almost every one that they feel healthier on a dry soil. In some way, which is not yet clear, a moist soil produces an unfavorable effect upon the lungs; at least, in a number of English towns which have been sewered, and in which the ground was thereby rendered much drier, it has been shown by Dr. Buchanan that there is a diminution in the number of deaths from consumption; and Dr. Bowditch, of Boston, demonstrated the same thing some years since. The evidence is very strong as to the fact of the connection, but the nature of the link between the two conditions, of the drying of the soil and the lessening of certain pulmonary diseases, is unknown. It is curious how opposed this observation is to the old and erroneous view, that in malarious and therefore wet places, consumption was less prevalent.

### Malarious Soils.

A moist soil greatly influences the development of the agent, whatever it may be, which causes the paroxysmal or intermittent fevers. The conditions which must be present to produce this agent of disease are, heat of soil, which it is requisite should equal that found on the isothermic line of sixty-five degrees of summer atmosphere temperature, access of air, moisture of soil, and some impurity in the ground, which in all probability is of a vegetable nature. The rise and fall of the ground-water, by supplying the necessary degree of moisture, or, on the contrary, by making the ground too moist or too dry, evidently plays a large part in pro-



ducing or controlling periodical outbreaks of paroxysmal fevers in the so-called malarious countries. The development of malaria may be connected either with a rise or with a fall of the ground-water. An impeded outflow which raises the level of the ground-water has, in malarious soils, been productive of an immense spread of intermittent fevers. This was illustrated on a terrible scale in the outbreak of malarious fevers occurring in Amritsar, India, in 1881. The total number of deaths was nearly seven thousand, of which more than half were among children under twelve years of age. As many as ten thousand cases were under treatment in one day. The sanitary commissioner appointed to investigate the outbreak unhesitatingly attributed it to an excessive rainfall, obstructed drainage, and water-logging of the soil. In consequence of an excessive downpour in July and August, a large portion of the ground about the city was covered with water, and that in the city wells rose to within an average of six feet of the top. Indeed, in one portion, where the drainage and the outfall were both very defective, the water in several of the wells actually stood on a level with the ground. After this inordinate rainfall the atmosphere was heavy and moist to an unusual degree, whilst from the damp soil, drying up under the influence of a hot sun, the ground-water at the same time beginning to subside, organic emanations from the decomposing animal and vegetable matter contained in the earth must have been given off in great abundance, for analysis showed that this well-water had been very much polluted. The opposite result of diminished intermittent fevers, and very malarious places rendered quite healthy, has been attained by increasing the outflow, and so lowering the level of the subsoil water in well-planned drainage operations. The general mode of rendering the soil drier is by putting in a system of deep drains, which should be laid some ten or twelve feet below the surface, and from ten to twenty feet apart, according to the amount of water to be removed, and also to the permeability of the soil.

It is generally admitted, remarks Dr. De Chaumont, that a persistently low ground-water, say fifteen feet down or more, is healthy; that a persistently high ground-water, say of less than five feet from the surface, is unhealthy; and that a fluctuating level, especially if the changes are sudden, is very unhealthy.

The production of an artificially high ground-water, by means of leaky sewers, seems to be almost equally bad, from a sanitary point of view; for in an investigation, suggested by the prevalence of diphtheria in New York City in 1872, it was discovered that many of the old water-courses and natural springs had been filled in years before without making any proper provision for free drainage of the soil, and, as the disease was especially prevalent along the lines of these old water-courses, it seemed highly probable that the defective drainage of the subsoil was concerned in its causation. Two-thirds of the deaths from cholera in Dublin,

during the epidemic of 1866, are stated to have taken place on or close to the sites of old water-courses, which had been converted into sewers or filled up with mud.

### Other Insalubrious Conditions of Soil.

In estimating the salubrity or unhealthiness of a soil, certain general features of its surface must be considered, namely, the relative amounts of hill, valley, and plain; their inclination, elevation, and course; also the direction and discharge of water-sheds and channels. Among hills, the unfavorable spots are valleys and ravines, where the air may stagnate. On plains, they are at the foot of hills, and at points where the general surface of the country is depressed.

The effect of vegetation is important, a thick growth of trees impeding the action of the sun's rays, and rendering the ground cooler and more moist. This is, of course, apt to prove more favorable to health in hot climates, and less so in higher latitudes, where the removal of wood renders the climate milder. Trees often obstruct the passage of currents of air by their branches, and the flow of ground-water by their roots, to a considerable extent. The absorption of heat from the sun's rays varies with the nature, color, and density of the soil. Even in temperate climates, blackish sands may become heated by the sun to  $122^{\circ}$ , and in India their temperature has been found as high as  $160^{\circ}$ . Soils covered with grass or other herbage absorb less heat and radiate more freely, and it has been shown that the power which the radiated heat has of passing through the air further varies with the nature of the surface from which it is radiated. There is little doubt that the temperature of the soil has a great influence upon disease, powerfully affecting the prevalence of malaria, and perhaps the spread of cholera also. Most soils consist of mineral matters and water, with varying proportions, as already stated, of vegetable and animal materials. These latter ingredients are apt to be more abundant around thickly-settled neighborhoods, on account of the refuse matter thrown out and cast away. As an example of this mode of addition of filth to the constituents of the ground, it is stated that, in certain loose soils, cess-pits which have been used for fifty years without emptying are still not full, owing to soakage of their disgusting contents into the surrounding earth, where, of course, it pollutes the soil, and soon mingling with the ground-water, finds its way more or less abundantly into all the wells of a district. This kind of animal matter in the soil, composed of the excrement of living creatures and the decomposing bodies of these same animals after death—man being, of course, included—constitutes a small but dangerous, and therefore most important, ingredient in the soil. It is probable that these foul products of animals and their putrefying remains are only or chiefly hurtful if the natural process of conversion by vegetables into useful articles of food is

interfered with, as it is in cities, where the devices of civilization, such as paving, building, and so forth, may absolutely prevent the development of that vegetable life which is so vitally necessary in some instances to successful animal existence. These devices, then, which interfere with nature's method of preventing injury to health by decomposing animal matter, must be supplemented and compensated for by other human contrivances, such as drains and sewers, which shall convey away the superabundance of animal substances beyond its sphere of injurious action upon living human organisms. The failure to accomplish this completely is the cause of much of the unhealthiness of old towns and cities, which has so often been the subject of complaint, and ought to be most carefully guarded against by watchful precautions against pollution of the soil.

Microscopical examination of soils will often throw much light upon the nature of their animal and vegetable ingredients, but our chief reliance for a knowledge of the mineral constituents of soil must be upon a thorough chemical analysis.

According to the best authorities, districts underlaid by granite, trap, clay-slate, chalk, and sandstone are generally healthy. Sand and gravel soils may be healthy or unhealthy according to circumstances. Limestone, especially the magnesian limestone, clay, dense marl, alluvial, and made soils should be regarded with suspicion. Well-cultivated soils are often healthy, and up to the present time it has not been positively proved that the use of manure is injurious. Irrigated lands, and especially the rice-fields of the Southern States, which not only expose a large surface to evaporation, but also send up a vast amount of organic matter into the air, are hurtful. So fully is this established by long-continued observation abroad, that in northern Italy, where there is a very perfect system of irrigation, laws prohibit the planting of rice-fields within about eight miles of the chief cities, and five miles and a half of the towns and military posts.

### Varieties of Malarious Soils.

The efficient conditions for the production of the malarial poison appear to be some kind of decomposition or fermentation going on in the soil, which in its turn is dependent upon the presence of organic matter in the ground, heat, moisture, and limited access of air. It seems to be clearly demonstrated that the mineral constituents of a soil have little or nothing to do with the production of malaria, which will prevail on chalk, limestone, and even, under special conditions, on granite soils. The following soils, according to Dr. Parkes, are known to be concerned in the evolution of the poison giving rise to the periodical fevers in the malarial zone: First, marshes, except those with peaty soils, those which are regularly overflowed by the sea and not only occasionally inundated, and



marshes in the Southern Hemisphere, especially Australia, New Zealand, and elsewhere, which for some as yet unknown reason do not produce malaria. Chemically, the great characteristic of the soil of these marshes is the immense quantity of vegetable organic matter which they contain. A marsh in Trinidad gave, on analysis, thirty-five per cent., and the middle layer of the Tuscan Maremma, thirty per cent. In this latter marsh, which must have existed many centuries, if not thousands of years, a great number of the plants are still undestroyed, showing how slowly the decomposition of vegetable matter imbedded in the soil goes on. It seems tolerably certain that the coarse-growing vegetation covering marshes has nothing to do with the development of malaria.

Many alluvial soils, especially those which are recently formed, give out malaria, although they are not marshy. Frequently alluvial soils have a very flat surface, with consequently a poor drainage, and are in the vicinity of streams, which may cause marked variations in the level of the ground-water. Mud-banks also on the sides of large streams, especially if only occasionally covered with water, are apt to be highly malarious. The soils of many tropical valleys and ravines are alluvial, and in many cases large quantities of vegetable matter collect in them; so, if there is any narrowing at the outlet of the valley, the overflow of the rains may be impeded, with dangerous results to health from malarious diseases. Of like nature are sandy plains, especially when seated at the foot of tropical hills, and more or less covered with vegetation. In other and more favorable cases, the sandy plains are at a distance from hills apparently dry, and not much exposed to variations in the level of the ground-water. Under some sands, a few feet only from the surface, lie beds of clay, and the sand, being kept moist by evaporation of water retained in this stratum of clay, is rendered a favorable seat of vegetable decomposition. Under great heat a minute percentage of organic material may thus be kept in a state of change. This is especially the case along the dried beds of water-courses and torrents, where there is very often a subterranean stream, and the ground is impregnated with vegetable matter. In some instances the sands may be only malarious after rains of some duration, when the upper stratum is retained in a moist condition.

Certain hard rocks, especially when they have been disintegrated upon the surface, have the reputation of proving very malarious, and the same is stated to be true in regard to the magnesian limestone rocks which have been subjected to volcanic action.

The conditions under which malarious soils affect human health will be considered more in detail in subsequent pages upon Miasmatic Influence as a Cause of Disease.

### Contagion as a Cause of Disease.

The subject of the contagious or catching diseases is of the greatest importance in relation to preventive medicine, because in this large class of dangerous maladies it is possible, by the exertion of sufficient care, according to the modes pointed out in this chapter, to preserve entirely the health and life from their power. The word contagion is derived from the two Latin words *con* and *tango*, and therefore means literally to touch together. It is now, however, defined by medical authorities as a morbidic or disease-producing cause, the product of a peculiar disease which is capable of producing the same disease in another person, and of thus propagating itself and the complaint of which it is at once the cause and the effect through any number of individuals.

Very recent writers maintain a distinction between contagion and infection, restricting application of the former to disease-poisons which are only capable of reproducing themselves in the human body, and employing the latter to indicate a morbidic agent, which is also able to propagate itself, under favorable circumstances, outside the body of man.

The type of a contagious disease is small-pox, and the intense virulence of its contagion is a matter of popular notoriety and apprehension. It has been proved in multitudes of instances, as for example in the cases of four medical students, who took the disease from the body of a man dead with small-pox, which was brought for dissection into Mr. Cæsar Hawkins' anatomical rooms, in London, although only one of these students touched the corpse.

At the present time a prize of \$5,000 is offered in England for a practicable method of cultivating vaccine virus outside the human body; and should this valuable discovery, thus stimulated, be made, cow-pox, or the vaccine-disease, must thenceforth be ranked as both a *contagious* and *infectious* malady. Some kinds of contagion are solid, some liquid, and others diffuse themselves through the air of a room or of a whole house. In the solid or liquid form, they generally act by simple contact, as in the venereal disease, or by application to a wound or abraded spot upon the skin, no matter how minute, as in hydrophobia or in vaccination. In their aeriform state, they produce their effects through the medium of the atmosphere, no doubt chiefly by inhalation into the lungs. In all cases, they appear to accomplish their infective destiny by absorption, either through the epidermis, the abraded surface of the subcutaneous tissue, or the lining mucous membrane of the lungs, mouth, and throat. The Chinese method of inoculating small-pox, which they called sowing the disorder, was formerly by stuffing the dried crusts of the pocks up the patient's nostrils, whence fragments of dust were probably carried into the patient's lungs during inspiration.

The contagious material may be the product of some local action, such

as a sore or ulcer in the individual, or it may be connected with a general contamination of the system, and exhaled from all the free surfaces of the body, as in small-pox or measles. It has, as far as we have been able to determine, no sensible characteristics by which its poisonous properties might be indicated, nor does it yield any evidence of its deadly nature to chemical investigation. In some diseases, as in small-pox and typhus fever, it is often attended by a disagreeable odor, and yet it is by no means certain but that the contagion itself is inodorous.

In our present state of civilization, the specific poisons by which the communicable diseases, such as small-pox and typhoid fever, reproduce themselves, seem never to be totally absent from among mankind. Yet it is only under conditions favorable to their dissemination that the specific diseases, which are constantly existing somewhere in a large community, spread actively and become epidemic. Although their germs—specific gases, active principles or materials of propagation and development, whatever they are—may lie dormant or latent for a time, it is not to be inferred that they have ceased to exist. The history of all the specific communicable diseases demonstrates the same alternations of slumber and activity, of almost universal prevalence in one place whilst neighboring localities may remain free, and finally the same successive invasion of places in close juxtaposition, in such a manner that the disorder only begins to prevail in its new situation about the time it dies out in the old. In large cities the specific poisons are always more or less active, and their resulting diseases always present, but in country districts they only now and then occur. These long periods of exemption in country places are not traceable to any feebleness in the specific poison, for, when the disease does become developed in these places, the ratio of persons or of animals attacked is often very much greater than is usually seen in cities under like circumstances. In large towns, the sewers are probably continually charged with the germs of the specific diseases always abounding in densely populated districts. In small villages and other places, where no sewers exist, the air may become infected or the water contaminated by the direct or indirect importation of cases of specific disease, or their equivalents, the poisons themselves. Hence the organic impurities, the dung-heaps, or even the open soil which surrounds the dwellings of patients, the cess-pools common to several houses, gradually but surely become impregnated with the specific poisons of disease. Thus it may happen that the atmosphere of a village may become far more virulent than the air of the sick-chamber itself. Hence, too, the rapid spread of some epidemics in the limited space of some rural districts, which gives rise to the popular error that such maladies are invariably contagious in country places, and only rarely so in cities or large towns.

It is worthy of especial notice that all these specific diseases multiply their kind after similar modes of propagation. Each of them establishes



a constant series of morbid changes, and always results in the reproduction of its own specific germ, or active principle, by which it propagates its kind. Thus small-pox generates small-pox only, measles reproduces measles, scarlet fever multiplies scarlet fever, typhoid fever breeds typhoid fever, typhus, typhus, and so on. In the most diverse races, under climates the most various, age after age, through endless generations of man, these diseases pass down through the human body, sometimes through animals, as, for example, in sheep-pox, each perpetuating its own kind and maintaining its separate identity, by marks as specific as those which distinguish the grape from the thorn, or the fig from the thistle. Such being the fact, it is difficult to conceive that diseases of which this is the history can ever be generated, at least in our own times, in any other way.

Most of these specific contagious diseases are peculiar to man, whilst animals on their part are infested by a whole brood of communicable maladies, no less specific in their kind, incapable of being conveyed to man, although certain ones have the power of multiplying in the human body. Cattle, for instance, seem to be subjected to a variety of malignant and communicable fevers from which our race is altogether exempt, whilst the kine-pock in the bovine race, which is so easily inoculated into the system of man, flourishes so vigorously in the human soil that it is capable of reproducing itself hundreds of times in the bodies of successive infants who undergo vaccination from virus generated from a single minute particle of the original crust.

Certain receptive conditions, or a predisposition, the nature of which is as yet unknown, exist in individuals, which appear essential to the development of the specific poisons, and the establishment of the disease. An immunity against the repetition of a malady is generally conferred by one attack of a contagious disease. This safety has been proved real upon an enormous scale in regard to small-pox, and, in relation to the other contagious disorders, a belief in such immunity from second attacks is founded upon very extended observation; but the protection acquired by a first attack of any of these diseases is of no avail against the rest. Measles, for instance, renders the human body proof, as a rule, against measles, but leaves it as open to small-pox as before, and so on with all the rest.

With regard to the co-operative effect of fermentation, putrescence, or decomposition, there is some reason to believe that it may quicken the activity or facilitate the development of specific morbid poisons in the way of a predisposing cause to their reproduction. There is no small amount of circumstantial evidence tending to show that conditions of this kind may be thus far favorable to the propagation of specific diseases, even to the extent of rendering them epidemics, in consequence of the predisposing agency of putrefying emanations. On the other hand, the

tendency to decay, decomposition, and destruction of the specific germs, or disease-poisons themselves, often serves to render inoperative influences which would otherwise be dangerously effective. The disease-poisons, like all organic substances, propagating from minute or invisible germs or spores, are stamped with an irresistible tendency to change and perish, so that in all probability myriads of germs are destroyed in the struggle for existence where one proves fruitful. This is especially the case with the vegetable parasitic affections, whose germs would overrun the world if they all came to maturity. The destruction or dispersion of these specific poisons is provided for in innumerable ways, through the operation of many natural causes, and by imitating some of these processes of nature we may eventually be able to exterminate, or at all events greatly to modify, the severity and reduce the mortality from many of these diseases, as is shown by Pasteur's researches.

#### Contagious Diseases Always Come from Contagion.

The belief in a spontaneous origin of the contagious diseases rests on entirely negative evidence, namely, the fact that cases do occasionally spring up in which it is impossible to trace the disease back to a personal source of propagation and dissemination; and yet such an event is only what we have to expect from the very nature of these diseases, for the active principle of the poison is invisible. This is true, although the matter which is known to contain it may be capable of isolation and inoculation, as is the virus of small-pox, and yet the existence of the specific disease-poison of this terrible malady is positively known to us by inference only. Again, we know that ample provision is made and ways are open for the dissemination of the active agent of propagation in a thousand unseen modes, so that it is obvious that the precise source of the infection and its track will often baffle the best wisdom of man to discover or trace.

Cases frequently arise, in some such modes as those just indicated, which give some countenance to the erroneous and pernicious belief that the disease which may have broken out has had a spontaneous origin, in other words, that it has been sporadic, as it is termed. Numerous attacks of scarlet fever, measles, small-pox, and so forth, occur which can never be traced to their sources, or to any communication with persons similarly diseased, yet the history, at least of small-pox, is conclusive against any theory of its spontaneous origin, and if such is the fact in regard to it, how can we doubt that the other specific diseases, apparently identical in their nature, have, after they once were created, followed the same rules, and bringing forth after their kind reproduce themselves almost without variation. Most physicians in active practice meet with cases illustrating the occult modes in which the poison of these contagious diseases is disseminated. Thus, for example, the present writer, during a small-pox epidemic many years since, knew of a country lad who, being attacked with

small-pox while in the city on a visit, was dressed up by his friends as a girl, so that he could be shrouded in a thick veil without arousing suspicion, and, in spite of all remonstrance, was taken by more or less crowded street-car, ferry-boat, and railroad train, to his home in a neighboring State, of course at the risk of numerous lives. Again, during the same outbreak, were attended two cases of small-pox in the house of a ready-made clothing dealer, whose coats and vests were probably all infected with the virus of the malady, and went out of his shop on the backs of hundreds of customers, who were thereby subjected to the deadly peril of contracting that loathsome disorder without the slightest warning of their danger.

Instructed by these and similar occurrences, the author recently advocated the passage of a law, making it an offence punishable by fine and imprisonment to wilfully or negligently, after being duly warned, convey a contagious disease, such as small-pox, to any healthy person. Such laws are strictly enforced in Great Britain, with the best results, in protecting the community from temporarily dangerous persons, who are affected with or convalescent from one of the infectious disorders.

In support of the important assertion made above, that no sporadic or self-originating case of small-pox has occurred, at least in our own times, it is only necessary to refer to its introduction into our Western Continent of America. Here our knowledge of events is precise and accurate, and we are well assured that there was no small-pox existing in the New World at the time of its discovery by Columbus, in 1492. In 1517 the disease was imported into San Domingo. Three years later, in one of the Spanish expeditions from Cuba to Mexico, a negro covered with the pustules of small-pox was landed upon the Mexican coast. *From him* the disease spread with such desolating power that, within a very short time, according to Robertson, three millions and half of the inhabitants were destroyed by it in that kingdom alone. Again, small-pox was introduced into Iceland in 1707, when, by its ravages, sixteen thousand persons were carried off, constituting more than one-quarter of the population of the island. It reached Greenland still later, appearing there for the first time in 1733, and spreading with such rapidity and fatality as almost to depopulate the country. "No common condition of human life," says Dr. Aikin, "gave rise to such frightful phenomena as these; propagation from the actual poison of some pre-existing case was the one necessary and all-sufficient cause for these endemic outbreaks of small-pox and their epidemic prevalence." The precise mode in which the contagious diseases with their specific poisons first come into existence is beyond our ken—hidden from us as yet by a thick veil, and remaining an inscrutable, or at least an unpenetrated, mystery. But everything tends to show that, once created, they all propagate only in one way, namely, by continuous succession.



Admitting, as these facts seem to compel us to do, that contagion from some pre-existing cases is the one sole cause of illness in every person who is now suffering, or who ever will suffer, from any contagious disease, it is obvious that learning how to avoid this contagion as far as possible is one of the most important duties of practical hygiene. The value of such knowledge is demonstrated by the fact that, in Philadelphia alone, out of a total death-roll for the year 1881 of 19,515, small-pox proved fatal to 1336 persons, scarlet fever to 486, diphtheria to 457, and typhoid fever to 645. In other words, complete avoidance of contagion in the city of Philadelphia, during that year, would have prevented nearly three thousand premature deaths from these four maladies alone, or more than one-seventh of the entire mortality. And this is but a small part of the benefit, for during the same year there were nearly four thousand non-fatal cases of small-pox, and a still larger proportion of the other diseases, so that the amount of human suffering not ending in death which could be saved by cutting off all sources of these contagions, is of still greater importance from a sanitary point of view.

#### The Real Nature of Contagion.

Numerous and violent have been the controversies which were formerly waged, and are now carried on, in the medical world, as to the essential constitution of the contagious materials which convey their respective disorders. Without entering far into these discussions, it will be sufficient to state here that the germ-theory of disease, although still doubted by some, is rapidly gaining advocates among all progressive physicians, and now forms at any rate by far the best working hypothesis, in accordance with which public and private sanitary precautions against the spread of infectious diseases can be organized. In its favor the following words of the present writer, published fourteen years ago, still present a powerful argument, although the proof to which they refer has since been furnished in regard to one or two of the contagious maladies. At that time, after mentioning that certain able microscopists had failed to discover any special cryptogamic germs in the blood, the author remarked: "Nevertheless, when we remember that the great law of nature appears to be a never-ending struggle, wherever possible, of each organism and every class of organisms, *for its own existence against every other form of life*, and recall the fact that, in the vegetable world, such devastating plagues originate in the growth of the cryptogams, which produce the vine-blight, the potato-rot, and rust and smut in the cereals, it seems highly probable that some, perhaps the same, minute organic entities, contemptible in their immeasurable minuteness, but terrible in their almost infinite number, do possess like destructive powers over the animal kingdom, and that their discovery, when made, if it be not already accomplished, will ultimately enable us, far better than ever before, to struggle with disease."\*

\* Hand-Book of Medical Microscopy, p. 196. Philadelphia, 1871.

### The Germ-Theory of Disease.

In order to make the sanitary precautions thus rendered advisable clearly understood, it should be explained in the first place that the germ-theory of disease, traced by some to the celebrated Pliny, vastly extended by the renowned botanist, Linnaeus, more than a century ago, and since somewhat modified by its successive advocates, professes to account for the phenomena of small-pox, typhoid fever, yellow fever, relapsing fever, measles, scarlatina, diphtheria, chicken-pox, erysipelas, and so forth, by attributing them to the more or less mechanical irritation, obstruction, and other disturbances set up by masses of spores and mycelial threads developing in the blood and in the affected tissues. The period of incubation (by which is meant the time between exposure to small-pox, for example, and the development of the complaint) is supposed to correspond with that required for the germination of these spores. The gradual increment of the symptoms is attributed to the progressive growth of the millions of minute fungoid plants, whose period of greatest luxuriance marks the acme of the attack, and the death and destruction of which correspond to the decline of the disease. The contagiousness of the communicable maladies is accounted for very beautifully by the existence of the immense number of spores, forming the true seeds of disease, constantly produced, evolved from the affected individual, and carried through the air of a room or house either alone or attached to some of the innumerable epithelial cells, which are being rubbed off by millions from the surface of human bodies. (See Fig. 4 on p. 86.)

The general absence of second attacks is admirably explained by the hypothesis that the parasitic fungus on the first occasion has exhausted all, or nearly all, of some peculiar (unknown) organic ingredient in the body, which is absolutely requisite for its support, according to the very same law that will cause, as every farmer knows, his wheat to fail if he plants it repeatedly in the same ground and neglects to secure a due rotation of crops.

Hence, according to this doctrine, contagious diseases are conveyed from one person to another by the transplanting of microscopically visible spores or seeds which have a separate vitality of their own, each after its kind, and which are to be escaped just as one would escape hordes of animal or swarms of insect pests by shutting them out or killing them before they can succeed in fastening upon human bodies.

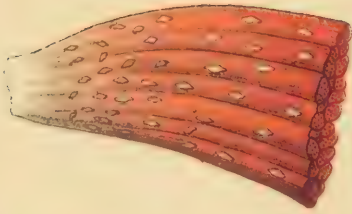
It is curious how we see to-day, in regard to small-pox and diphtheria, the same old battle fought which fifty years ago was so strenuously contested by Bielt and Morgagni on the one hand, and the microscopists on the other, in relation to scabies or the itch, now universally admitted to be caused by a tiny insect which burrows beneath the human skin. To the student of human nature it is a most interesting confirmation of the



wise king's dictum that there is no new thing under the sun, to observe how the same doubts, followed by the same objections, were urged against the parasitic character of the itch that are now put forward in opposition to the vegetable nature of the cause of the contagious diseases. Thus Bielt, Cazenave, Lugol, and others, denied then that, even with the aid of microscopes of high power, any insect whatever could be discovered. When, by a succession of lucky accidents, so many observers blundered into seeing the insect that this position was no longer tenable, opponents to the parasitic theory changed their base of operations, and, admitting the occasional existence of the acarus, stoutly maintained that, instead of being the cause of scabies, it was a secretory product of that affection and by no means a constant one. Finally, when *proof* that the whole disease could arise from the deposit of a single itch-insect upon the skin of a previously healthy person became incontestable, the anti-microscopists took refuge in the assertion that, in such cases, "the insect taken from the scabious vesicle, *being charged with the virus, the fluid of the vesicle*, by penetration of the cuticle, inserted this virus, and produced the disease," as the inoculation of cow-pox is accomplished.

As having an important bearing upon the hygienic precautions instituted, great benefit would probably result from its being understood by every man, woman, and child that the contagion of small-pox, scarlet fever, typhoid fever, yellow fever, measles, diphtheria, cholera, and so on, is composed of exceedingly minute spores or seeds, so small that 25,000 of them, placed end to end, would measure less than one inch in length; and a mass the diameter of one of the periods (.) upon this printed page might contain 64,000,000. Each one of these 64,000,000 of seeds is capable, under favorable circumstances, of reproducing its kind with almost inconceivable rapidity; so that, supposing, for example, the *zygodesmus* of Prof. Letzerich is really the morbid agent causing diphtheria, a particle of the grayish, false membrane of the size of the dot just mentioned would contain separate seeds enough to infect every inhabitant of the whole continent of North America with diphtheritic disease. But whilst this is the theoretical possibility, practically, the same law of the prodigality of nature, exemplified in the spawn of the herring and salmon, holds good, and not more than one spore in a thousand, a million, or a hundred millions, perhaps, has an opportunity to reproduce its species. As there is no doubt that the contagion of the diseases just enumerated may penetrate into our systems by the air that is breathed, the food that is eaten, and especially the water that is drunk, it is obvious that only the most scrupulous care can save us from these extremely minute seeds, or insure their destruction after entrance into our bodies is accomplished. If these germs were singly disseminated, it would be almost impossible to avert constant infection; but as they generally are carried about by winds or currents in aggregations of thousands or tens of thousands, of course





*Encysted Trichina in Human Muscle.*  
Double natural size.



*Trichina in Human Muscle.*  
Highly magnified.



*The Cholera Germ and four Intestinal Cells*  
(Comma Bacillus)  
Magnified to 400 Diameters.



*The Fungoid Growth causing Consumption*  
(Bacillus Tuberculosis)  
Magnified to 800 Diameters



the chances of imprisoning them, or otherwise shielding ourselves from them, is largely increased. It seems probable that the epithelial cells, continually shed from our integument and constantly floating about in the atmosphere in great numbers, and which are met with in the dust deposited upon the highest points of four-story buildings, in crowded thoroughfares, are often vehicles for small groups of these spores, which adhere to them.

The obvious deductions from these facts tend to strengthen the urgent recommendations of sanitarians, that every effort should be made, first, to prevent these morbid germs from being let loose upon the world; and second, when they have made their escape into the free air or water, to destroy all spores likely to come in contact with unprotected persons—that is to say, human beings from whose bodies one crop of small-pox (or cow-pox) fungus, yellow-fever bacteria, relapsing-fever spirilla, and so forth, has not already been raised. Each individual affected with small-pox, scarlet fever, diphtheria, or any other of the diseases above mentioned, is, according to this theory, to be looked upon as a sort of hot-bed or forcing-house for the seeds or spores of that malady. From his or her body are continually given off in all directions, by the skin, the breath, the perspiration, and other secretions, millions of spores of the extreme minuteness just described, each one of which, if it were received into a human system, under favorable circumstances, would rapidly reproduce itself, and, after a few days or weeks (corresponding, as already mentioned, to what is known as the period of incubation), give rise to a new case of the disease, again a new hot-bed of contagion for other unprotected organisms.

Now, these spores, just like the seeds of larger noxious weeds, which, when allowed to gain a foothold in fields and gardens, propagate themselves with such immense rapidity, have no power to move of their own accord, and can only develop if they meet with air, moisture, and congenial soil suited to their peculiar requirements—that is, if a small-pox patient is shut up in an air-tight room, so that the seeds cannot escape; or if, whilst in the open air, that air is stagnant, so that no seeds are wafted away from the immediate neighborhood of the individual; or if, when carried along by the wind, they are blown away from any human habitations, or are desiccated in a dry atmosphere, baked by the sun's rays or artificial heat, frozen by extreme cold (as seems to be the case with yellow-fever germs); or, finally, if they happen to meet with no persons but those who have had small-pox or been sufficiently vaccinated; in other words, if they do not "fall upon *good ground*," all this wealth of provision by which nature tries so hard to secure the perpetuation of the poisonous plant causing small-pox in our systems, becomes unavailing, and her malevolent design against our race, carried out with such a prodigality of murderous weapons, utterly fails.



This brings us to the notice of one of the most common and most mischievous popular errors which a general acceptance of the germ-theory would necessarily subvert, namely, the belief that small-pox and other contagious maladies often arise without previous exposure to the seeds of disease. Such a doctrine, frequently advanced in private life by lazy and ignorant or perverse persons as an excuse for neglect of proper care and caution in regard to children and others, and occasionally sustained by public authorities as an apology for violation of quarantine and similar sanitary regulations, is exceedingly pernicious, and the warmest gratitude would be due to the germ-theory of disease even should its establishment render no other service to humanity than the explosion of this fallacy. The fact is that (inverting the Scriptural aphorism) we can no more gather thorns from grapes, or thistles from figs, than we can have, for instance, the germs of small-pox growing from clean clothing, or those of cholera developing from uninfected rice.

Putting aside the primary origin of contagious diseases, which, with one or two doubtful exceptions, is a question of prehistoric time, the germ-theory of disease teaches that every new case of the contagious maladies already enumerated, is the immediate offspring of a preceding case, and the direct result of exposure of an unprotected human being to the chance of having the spores or seeds of disease implanted in its system, an exposure which it only required sufficient knowledge, sufficient foresight, and sufficient care to avoid.

This pernicious belief in the spontaneous endemic origin of the contagious diseases rests at any rate on entirely negative evidence, namely, the circumstance that cases do sometimes spring up in which it is impossible to trace the affection back to a personal source of specific propagation; and yet such an event is only what we have reason to expect on general principles, as already pointed out, from the very nature of these diseases, since the living germs are utterly invisible to the naked eye. Hence, in the ordinary affairs of life, unless special precautions are resorted to, ways are open for the spread of these microscopic agents of propagation in a thousand unseen modes, so that obviously the precise source of infection and its course through the air, or from person to person, must often remain undiscovered by the best wisdom of man.

In all instances of contagious disease, then, isolation from unprotected persons, carried out with every due consideration and kindness, is therefore to be practiced if possible, and under other conditions means which will destroy the life of the spores, such as dry heat of high degree, superheated steam, prolonged boiling in water, caustic acids or alkalies, are to be used with a firm confidence that, if they are employed thoroughly enough, they will absolutely put a stop to all spread of the disease.

A very important suggestion in regard to the use of disinfectants arising from our knowledge of the germ-theory is that, since these spores

doubtless float in the atmosphere, as do the seeds of the thistle or dandelion, and are no more susceptible to the action of chemicals with which the air containing them is impregnated, it is useless to expect any certain and complete results from the milder aerial disinfectants as usually employed, that is, by scenting the medium in which disease-germs are suspended with carbolic acid, camphor, acetic acid, and similar non-corrosive agents.

As to the lesson we may deduce from these teachings in regard to public hygiene, its importance is only surpassed by its simplicity. For such contagious and infectious maladies it is: *Avoid at any cost the entrance into communities of living spores or seeds of disease.* And this should be insured, not as in former times, with the mere *hope* that somehow we might escape the visitation, but with the absolute certainty that, with proper care, infection cannot occur.

No doubt many Americans have smiled at the story of certain terror-stricken authorities in a German town who, when a single potato-bug was discovered in a field near them, immediately covered the whole plantation with straw soaked in kerosene, and setting fire to it destroyed every vestige of animal and vegetable life for acres around. And yet, if we consider a moment, we must realize the fact that this apparent waste of time, trouble, and potato-vines, was the wisest and most economical expenditure that could possibly have been made.

How much more then, when men's own lives and the lives of those that are dear to them, in addition to scores of millions of dollars, are at stake, as they were in the South during the bad yellow fever epidemic of 1878, should sanitary authorities be armed with almost despotic power, in order that they may shut out or kill every one of these actually demonstrable, and even tangible, seeds of disease. Quarantine, disinfection and prolonged detention of persons, with disinfection or frequently total destruction of goods from infected districts, is apparently the right of the many at the expense of the few; and even if, as many would advocate for the sake of strict justice, ample compensation for loss of time and loss of property were allowed by law to those who suffered, the community at large would doubtless be tenfold better off pecuniarily, to say nothing of the far more important saving of human life and human suffering which would be secured.

In almost all the contagious diseases, some particular part or parts of the body are chiefly affected, and these specially implicated portions are the most prolific sources of the contagion, which is cast off from them in peculiar abundance. The epidermic scales and epithelial cells, shed in cases of scarlet fever from the skin, mouth, and throat, and the false membrane found on the tonsils in diphtheria, have been proved by innumerable observations to contain the respective poisons of these diseases, and to be able to retain their infective power after exposure to the air for



weeks, and even subsequent to their becoming perfectly dry. And it is well known that the poison of small-pox and of vaccine-disease exists in the dried scabs of the pustules of these two complaints. An instructive illustration in regard to the manner in which these seeds of disease are sown broadcast is furnished by the following curious case: Dr. Ross tells us that on one occasion he attended a case of confluent small-pox, and on a certain afternoon, when the patient was convalescent, a beam of sunlight happened to shine upon his back, as he sat by the fire during the doctor's visit. Dr. Ross immediately noticed that on the slightest movement of the patient clouds of epidermic scales, rendered visible by the rays of the setting sun, arose from the man's head and face, the heavier ones settling back upon his clothes, whilst the lighter atoms danced through the room in the sunshine. This event was a most suggestive one, and made a deep impression upon the doctor at the time, although he did not recognize its full significance until after reading of Professor Tyndall's experiments with the electric light, demonstrating the constant presence of vast amounts of dust in the open air. Obviously, the apartment in this case was filled with particles of epithelial scales and dried small-pox crusts from the patient. And no stranger entering the room could fail to draw into his lungs many millions of the seeds of the disease, nor could he escape carrying away upon his clothing a few millions of the same dangerous little atoms, except by a complete change of his outside garments immediately after leaving the chamber.

The exact physical condition, as to being solid or fluid, in which the different forms of contagion exist, has not been determined for all diseases, but there can be little doubt that the independent solid particles or germs are contained in the fluid pus, or corruption, as it is commonly called, flowing from ulcerated surfaces in the venereal diseases, and that terrible malady, childbed fever. In all the exanthemata or eruptive diseases, the contagious particles are given off from the skin generally. Thus, in measles, they spread from the skin, and also from the discharges of the mouth, nose, and eyes. In typhus fever and in plague, they are probably passing constantly from the skin. In typhoid fever and in cholera, the discharges from the bowels are the active agents known to propagate the disease, and hence must necessarily contain the energetic principle or contagion. Such discharges are further believed to impart their specific poisonous properties to excrementitious matters with which they are mixed, the poison reproducing itself in the new and previously non-poisonous material, to an indefinite extent, under favorable circumstances. In hydrophobia, the poison seems to be chiefly conveyed by the secretions of the mouth; in yellow fever, by the black vomit and other discharges from the stomach, and also those from the bowels and kidneys; in dysentery, in emanations from the evacuations; in whooping-cough, in the breath or emanations from the lungs. In some of these affections, the blood may



contain the material elements of the specific poison or contagion. This has been proved by actual experiment to be the case with venereal disease, and with the distressing malady sometimes conveyed from horses to man, called glanders. The bodies of persons dying with contagious diseases, may continue after death to be the means of propagating the affection. This is especially the case with small-pox, as already mentioned; and in the opinion of some, the contagion after death is particularly virulent and penetrating.

In our efforts to avoid the contagion of the different infectious diseases, it is manifestly of great importance to determine the periods in each of them during which the contagious property is active. In a general way, it may be stated that the power of giving off contagion begins as soon as the disease begins and lasts for a variable time after it is entirely over. Some diseases, such as measles and whooping-cough, are propagated as certainly whilst in the preliminary stage of incubation as when fully established. This period of incubation is made up of two stages, a stage of latency and a stage of invasion. During the first stage or period of latency, there are, as a rule, no symptoms indicating the presence of a disease-poison in the system. The second stage commences when the contagion begins to develop, and the patient is usually said to be sickening or coming down with the disease. This sickening is characterized by fever and constitutional disturbances, the general symptoms predominating over the local ones. During this period, the precise nature of the special disease may remain doubtful, although a knowledge of concurrent circumstances, such as the prevalence of any particular contagious affection in the neighborhood, will often enable a shrewd observer to guess the import of the febrile disturbance correctly.

The rapidity with which contagion acts appears to vary with the physical condition of the poison, and with the mode in which it finds ingress to the body. Thus, for instance, small-pox introduced by inoculation takes only nine days to develop, whilst when produced by the natural mode of inhalation, fourteen days are required. Measles introduced by inoculation takes seven days to incubate, and by inhalation, ten or twelve days. In some diseases, the incubation-period is rendered uncertain by the varying length of the period of latency. This is especially the case with small-pox, vaccination, mumps, chicken-pox, and typhoid fever. Diseases having a short period of incubation are especially scarlet fever, diphtheria, plague, cholera, diarrhoea, influenza, and erysipelas. The maladies intermediate between the two sets as to the length of their incubation-period are typhus fever, relapsing fever, and whooping-cough. When the incubation-period has been short, the respective contagions are more abundant, and the diseases are therefore chiefly infectious towards their termination. In those diseases where the incubation period is a long one, the early stage is generally a decided source of danger, but the

danger of infection from them also becomes greater and greater as the height of the disease is reached. This peril only ceases after all diseased action is over, and the evidence of past disturbance has cleared away, as, for instance, when the crusts of small-pox have fallen off, and complete desquamation or peeling-off of the cuticle in scarlet fever has taken place. In typhoid fever, it is thought, the contagion ceases to be given off soon after, if not as soon as, convalescence is established, whilst typhus fever is most virulently contagious, it is said, after a week of complete recovery. Whooping-cough is communicated with great frequency in its earliest stages, even before the characteristic "whoop" has manifested itself. Although incapable at present of absolute proof, there is good reason for the belief that the contagions of some of these specific diseases are constantly floating about in the atmosphere, at least of thickly inhabited places. This would seem to be particularly the case with those which arise from typhoid fever and cholera evacuations, when such maladies are at all prevalent, producing their primary effects not on the lungs or on the blood, but on the alimentary mucous tract, with which they come in contact by being swallowed with the saliva.

When the poison of one of these diseases is implanted through a thin or abraded cutaneous surface, or is directly introduced by a tooth or weapon, which inflicts a wound or an abrasion, and at the same time conveys the poison, a poisoned wound is the result, which produces general symptoms or propagates inflammation to other parts of the body, and the patient thus becomes inoculated with the specific contagion. The changes which the absorbed virus of specific diseases thus undergoes, in the living and infected body, are increase, transformation, combination, and separation or excretion. In these respects the specific poisons of diseases differ from the venoms of animals, such as poisonous snakes.

Contagion is often very capricious. Occasionally in a family of children one will be very ill with scarlet fever, for example, and the rest, although exposed to the seeds of the disease, will escape without being infected. At other times all the members of a household, except those protected by a previous attack, will take the disorder, in spite of ordinary precautions to seclude the affected child from his brothers and sisters. Still again, in instances which are fortunately rare, a first attack fails to afford the usual protection, and persons are a second, and even a third, time compelled to endure the suffering of the malady.

This variety of behavior is no doubt due to some constitutional peculiarity, either temporary or permanent, and has its complete analogy, if we accept the germ-theory of disease, among the larger plants, certain weeds or flowers growing with great luxuriance in particular places or soils, but utterly failing to establish themselves in other and apparently similar localities.

Unfortunately, we have as yet discovered no antidote for any of these



specific diseases. With one or two doubtful exceptions we cannot cure them. We can but guide the patient through them, with the best of our knowledge and experience, as to the means of maintaining life in a profoundly disturbed human body until the disease runs its natural course, and its malevolent power is exhausted.

### **Precautions against Contagious Diseases.**

Our great precaution against the worst and most terrible of the contagious maladies is, as the reader need scarcely be reminded, vaccination. The mode of applying this safeguard, for which the world owes a debt of gratitude to Dr. Jenner which it can never repay, with its advantages and limitations, will be discussed in the article upon Small-pox. As there are unhappily no such protectors as vaccination in regard to the other contagious maladies, such as scarlet fever, measles, and so forth, precautions against entering the sphere of their influence become doubly important, especially during epidemics of unusual fatality, or at times when the system is enfeebled in any way by other diseases or unfavorable conditions. These disorders are very apt to be propagated among school children, by the return of scholars recovering from measles or diphtheria, for example, before the poison has entirely passed off from their bodies, and without proper purification of their clothing. Such a pernicious practice should also be legislated against, but it can only be entirely abolished by the operation of an enlightened public opinion in regard to the injustice and criminality of this course of action. No individual who has suffered from measles or diphtheria, although the latter affection may have been so mild as to pass for only slight sore throat, can safely associate with others in less than two weeks from the date of complete recovery, and a period of from four to six weeks should elapse after scarlet fever before contact is allowed with children who have not been protected by a previous attack. Clothing, especially woolen fabrics, if not purified by thorough ventilation and disinfection, has been known to convey scarlet fever one, two, and even three years after it was originally impregnated with the contagion of this disease.

In a recent report from the French Academy of Medicine, made at the request of the government, it was declared that, with the exception of mumps and chicken-pox, the old-fashioned period of forty days isolation ought to be insisted on in regard to school children who had been affected with any contagious disease.

### **Scriptural Precautions against Infection.**

A most valuable lesson may be learned in reference to the thoroughness with which both disinfection and isolation should be carried out, wherever it is necessary, from the inspired instructions of the great Jewish lawgiver, as given in the book of Exodus, and called the law of the leper.



In this we find that sufferers from leprosy were driven out of the camp, and compelled to announce their infectious condition by rending their clothes, baring their heads, and crying "unclean." Their garments were carefully examined, and if found infected were promptly burnt. When a leper was apparently cured of his loathsome disease, certain troublesome, yet most important, precautions were ordained, which it would be well if our boasted nineteenth century civilization would adopt and enforce.

After inspection by the priest, the convalescent was obliged to shave his hair and wash his body and his clothes with water. After this he might go into the camp, but was not permitted to enter his own or any other tent. On the seventh day afterward he had again to shave his head, beard, and eyebrows, and wash his body and clothes, after which he was considered clean. The Mosaic precautions against the spread of leprosy by means of infected houses are most remarkably in accordance with the conclusions of modern sanitary science respecting the contagious diseases. Thus, if a house was pronounced by the priests to be leprous, the leprous stones were to be removed and cast into an unclean place outside of the city, where also were to be thrown the scrapings from the walls of the dwelling, and the coating thus removed was to be replaced with fresh clean mortar. Moreover, the law of the leper extended even to those who helped to cleanse the leper's house, doubtless because they were thus liable to catch the disease and convey it to others. Whoever lay or ate in the house had to wash his clothes, and if any one simply entered the leprous house whilst it was shut up, he was deemed unclean for the rest of the day. Moreover, if a leprous person died he was buried apart from others, and even kings and priests formed no exception to this rule.

If the walls of certain of our grand old hospitals, impregnated as some of them are with the germs of pyæmia, erysipelas, and perhaps other contagious diseases, could be pronounced leprous by human, as they have been by Divine, authority, and dealt with according to the ancient laws of the wise Hebrew legislator, what a blessing it would be to mankind!

### **Practical Disinfection in Contagious Diseases.**

With our present knowledge of the modes of propagation employed by the infectious maladies, it is obvious that the study of disinfection, or the destruction of the contagious material, be it vegetable, animal, or mineral, becomes of the gravest importance. Many persons, including, alas, not a few reputable physicians, seem to think that if they make an article of dress, a room, or a hospital smell badly enough of carbolic acid or chloride of lime to disgust even healthy people, they have accomplished disinfection, but such is often by no means the case. As a result of very carefully conducted experiments, it is found that no sewage or other virulent liquid can be regarded as surely and entirely disinfected by sulphurous acid gas from burning sulphur, unless enough of the gas has been

absorbed to render the fluid permanently and strongly acid to litmus paper dipped into it; also that no similar virulent liquid can be considered disinfected by carbolic acid unless it contains about two per cent., or about two ounces and a half of the pure acid, in every gallon of the fluid. Aerial disinfection, as commonly practiced with carbolic acid or chloride of lime, is useless or positively objectionable. See details in regard to disinfection under the head of Smallpox in Part II.

When any member of a family is attacked with small-pox, scarlet fever, measles, diphtheria, or other contagious disease, the malady may generally be prevented from extending by attention to the following rules, which are slightly condensed from those adopted by the English Society of Medical Officers of Health:

1. Separate the sick person from the rest of the family just as soon as illness appears, placing him, if possible, in a room at the top of the house, or in a side building, and taking care to remove carpets, curtains, all unnecessary clothing and furniture, previously therefrom.

2. Admit fresh air by opening the upper sash of the window. The fireplace should be kept open, and a fire lighted if the weather permits. Fresh air should be freely admitted through the whole house by means of open windows and doors. The more air that passes through the house the less likely is the disease to spread.

3. Hang up a sheet outside the door of the sick-room, and keep it wet with a mixture of either a quarter of a pint of carbolic acid, Calvert's No. 4, to the gallon of water, or a pound of chloride of lime in the same quantity.

4. Everything that passes from the sick person should be received into vessels containing half a pint of solution of green copperas, made by dissolving one pound of the copperas in a gallon of water. A like quantity of the copperas solution should be added to the discharges just before emptying them into the water-closet.

5. Every water-closet and privy about the premises should have at least a pint of one of these disinfectants poured into it daily, and the greatest care should be taken to prevent the contamination of well-water or drinking-water by any discharges from the invalid.

6. All cups, glasses, spoons, and so forth, used by the sick person, ought to be first washed in the above-named solution of carbolic acid, and afterwards in boiling or very hot water, before being used by any other individual.

7. No article of food should be allowed to remain in the sick-room. No food or drink that the sick person has tasted, or that has been in the sick-room, should be given to any one else.

8. All bed and body linen, as soon as it is removed from the sick person, and before being taken from the room, should be first put into a solution of carbolic acid of the above-mentioned strength, remain in it for about an hour, and afterwards be boiled in water.



9. Instead of handkerchiefs, small pieces of rag should be used, and these when soiled ought to be immediately burnt.

10. Persons attending on the sick should not wear woollen external garments, as they are likely to retain the infectious poison, dresses of cotton or some washable material being preferable. Nurses should always wash their hands immediately after attending to the patient, using carbolic acid soap, and wear a loose wrapper and cap, to be thrown off before leaving the sick chamber.

11. It is of the utmost importance that the sick-room be not frequented by others than those in necessary attendance upon the patient, as the clothing of visitors is very apt to carry away infection.

12. The scales and dusty powder which peel from the skin in scarlet fever, and the crusts in small-pox, being highly infectious, their escape into the air should be prevented by anointing the body of the patient all over every day with vaseline or camphorated oil. This and the subsequent use of warm baths and carbolic acid soap are most essential. The sick person must not be allowed to associate with the rest of the family until the peeling has entirely ceased and the skin is perfectly smooth. Clothes used during the time of the illness, or in any way exposed to the infection, must not be worn again until they have been properly disinfected.

13. When the sickness has terminated, the sick-room and its contents should be disinfected and purified as follows: Spread out and hang upon lines in the room all articles of clothing and bedding; close the fire-place, windows and all other openings tightly; then take half a pound or a pound of brimstone broken into small pieces, put it into an iron dish, supported on a pair of tongs or otherwise over a tub of water, place this in the middle of the room, and set fire to the sulphur by putting live coals upon it, or by pouring a little alcohol over it and lighting it with a match; when the fumes begin to come off freely shut the door, stop all crevices, and allow the room to remain closed up for at least twenty-four hours. The apartment ought then to be freely ventilated for a week by opening the doors and windows widely. Afterwards the paper should be stripped from the walls and burnt, the ceiling whitewashed, the furniture and all wood and painted work be well washed with carbolic acid soap and water, to which a little chloride of lime may be added; beds, mattresses, and other articles which cannot well be washed, should if possible, be purified by the action of a high heat in a disinfecting chamber, such as is now provided by the local health authorities in most large towns. Until this process of disinfection is effectually carried out, the room cannot be safely occupied.

14. Children should not be allowed to attend school from a house in which there is infectious disease, because, though not ill themselves, they are very likely to carry the infection, and so spread the disease. No child



should be allowed to re-enter a school without a certificate from the medical attendant stating that he can do so without danger of infecting other children.

When a patient dies of a highly contagious disease, such as small-pox, malignant scarlet fever, or diphtheria, the body should be washed with a very strong solution of carbolic acid or chloralum, double or treble the strength above mentioned, or, better still, enveloped in a sheet saturated with such a solution and placed in a coffin as soon as possible, the same disinfectants being sprinkled freely over it, and the lid screwed down. The burial should take place without delay, and, if circumstances render it very desirable that the corpse should be removed from the immediate neighborhood, it should only be done after the whole coffin is again thoroughly disinfected in the open air and then placed, with every precaution, in an air-tight metallic casket, and hermetically sealed up therein. The linen worn by the patient at the time of death, if not buried with the body, should be destroyed by fire at some distance from any house, or, when this cannot be done without creating a nuisance, it should be rolled up with a large quantity of quicklime and buried deeply in the ground.

It may be urged that many of these directions are needlessly minute, and that, in fact, they cannot possibly be carried out fully in perhaps the majority of cases. In answer to such objections, let it be said once for all, that no labor is wasted which aims at preventing distribution of disease, even though it be often attended with failure; and that, however limited be the means or opportunity of prosecuting preventive or precautionary measures, such means and such opportunity should always be employed to the uttermost, so as to make them productive of the best possible results, under the circumstances. As an encouragement to perseverance in such cases, the present writer has known, in his own experience, of a physician who, falling ill with malignant scarlet fever, was successfully nursed by his faithful wife, who also took charge during the day of their two young and unprotected children, without conveying to them the disease—the escape of the infants in this instance being justly attributed to the extraordinary care which the devoted mother resorted to in bathing, disinfecting with carbolic acid, and changing her clothing every morning after the night spent with her sick husband, before she entered the nursery. Moreover, it is not an unusual thing for Boards of Health to be able now to report that cases of small-pox introduced into communities from abroad, have been so thoroughly isolated, and the surroundings so successfully disinfected, that no extension of the malady, and consequently no epidemic of small-pox, has been the result.

### Epidemic Influence as a Disturber of Health.

The term "epidemic influence" has long been applied by the older writers to the unknown cause of such pestilences as the plague and black death of former ages, or cholera and malignant diphtheria in more recent times. With our present knowledge of the true nature of contagion, as explained by the germ-theory of disease, it is at least very possible that the phenomena attributed to epidemic influence are in reality produced by the extraordinary prevalence of the low forms of vegetable life, which constitute the potent disease-germs of the maladies above referred to. In the absence of absolute proof of this hypothesis, however, it is deemed best to consider this influence under a separate head, and acquaint the reader with the more important general laws of epidemics, and means of checking their progress, as deduced from a vast amount of careful observation, carried on by the acute physicians of past times.

Epidemics sometimes spread very rapidly, so as to incapacitate or destroy great numbers of people; but although, when actually developed, man often finds himself almost powerless to cure the attacks, yet by learning to know their laws accurately enough, we may frequently avoid them with absolute certainty.

In regard to the essential nature of the influence in question, all that we can as yet positively assert is, that in epidemics there must be some dis-tempered condition of the circumstances around us, some secret power that is operating injuriously upon our organisms, to which we give the name of epidemic influence or constitution, and which is believed to predispose to the reception of specific disease-poisons.

An epitome of the laws of this obscure agent, condensed from the excellent one of Dr. Aitken, is as follows:

1. The influence frequently predisposes to diseases, to all appearance independently of any other known cause, as in the cases of influenza and cholera. It makes itself manifest partly by giving increased energy to the causes which produce particular diseases, so that small-pox, scarlet fever, typhus fever, and the like, sometimes rage with great violence as epidemics. It also appears to predispose to new and strange forms of disease, as witnessed in the epidemic of boils which prevailed both in Europe and America about the year 1850.

2. Sometimes the epidemic influence appears to manifest itself by a certain type or direction, which existing diseases seem to take. Thus, at one time maladies appear to assume a low, or, as it is also called, a typhoid type, so that depletion is not tolerated. At another, an inflammatory tendency predominates, and depleting treatment is thought to be required. At certain periods there is a tendency in disease to be complicated its course by a disposition to affect particular organs. At one time head-affections predominate, at another time affections of the chest or of the alimen-

tary canal appear in the course of a prevailing disease. Consequently, the same disease may demand very different, and even opposite, modes of management in different epidemics.

3. During epidemics, other diseases are apt to assume more or less of the prevailing epidemic features. Thus, when cholera prevails, looseness of the bowels often complicates other affections—a fact which would lead us to avoid purgatives, as a rule, at such times. Again, when influenza abounds, catarrhal complications increase the danger of other diseases. Ill health of any kind therefore, favors the action of epidemic influence.

4. On the other hand, some change in the character of prevailing diseases, ordinarily of a constant and recurring kind, often indicates the *approach* of an epidemic, and the prevalence of the epidemic influence.

5. The first effects of the epidemic influence are usually the most marked and violent, and the cases of epidemic disease gradually become mild as the epidemic influence passes away. On this account medicines or modes of treatment which happened to be brought into notice during the latter part of an epidemic, have often gained temporary reputation for efficacy which they did not deserve, and which experience afterwards proved were almost baseless.

6. The epidemic influence sometimes disappears entirely after a short prevalence; sometimes continues with irregular intermissions for two, three, four, or even six years, or longer. Influenza and cholera illustrate this law.

7. An epidemic tendency, after continuing for several years, may give place to one of a different kind, which in turn may again be replaced by the first. In our own country, malarious fevers, yellow fever, and typhus are examples. The eruptive affections seem to run in somewhat similar cycles. After the introduction of vaccination, small-pox seemed for many years almost entirely subdued; but more recently again the disease has seldom been entirely absent from among us, alternating as an epidemic now and then with measles, scarlet fever, and typhus. We look forward, however, to the time when vaccination enforced by law will completely eradicate this disease.

8. The lower animals are also subject to epidemic influences, and seasons of unusual fatality among them have often coincided with those in which the human race has suffered severely. As illustrations of this statement, the propagation of the rinderpest among cattle in England, and of the epizooty among horses in this country, where it spread gradually from Boston to New York, thence to Philadelphia, from us to Baltimore, and afterwards to other southern and western cities, are too well known to require comment.

The general principles in accordance with which it is probable we can extinguish or “stamp out” most epidemics, are by cutting short the



spread in the first place of the specific diseases in question, as we prevent the production of fermentable matter in or out of the body, and in the second place, by preserving as much as possible the blood of every individual in that state which shall preclude these poisons from finding the conditions of their development within the system. This latter desirable object is to be attained by promoting the removal and chemical destruction or decomposition of all fermentable matter, when it is unavoidably generated, doing this especially by securing a free supply of pure air, and by reducing that air to the lowest temperature at which the condition of the individuals will allow it to be safely inhaled.

Full details in regard to putting the principles for controlling epidemics in practical operation would occupy more space than can be allotted to their present consideration; but the following points are too important to be passed over:

1. Whilst measures of precaution for protection of the healthy are equally proper for all ranks of society, it is chiefly with regard to the poorer classes—therefore chiefly in the courts and alleys of towns, and at the laborers' cottages of country districts—that local authorities are called upon to exercise the utmost vigilance and to proffer information and advice. Common lodging-houses, tenement-houses, and all houses which are sub-let to several small tenants, *always* require particular attention.

2. Wherever there is accumulation or soakage of house-refuse, or other decaying animal or vegetable matter, the nuisance should be abated as promptly as possible, and every precaution taken that it shall not recur. Especially, all complaints which refer to sewers and drains, to foul ditches, and pools of sewage, or to neglect of scavenging, should receive immediate attention. The trapping of house-drains or sinks and the state of cess-pools should be seen to. In slaughter-houses and other places where beasts are kept, strict cleanliness should be enforced.

3. In order to guard against the injury which sometimes arises from disturbing heaps of offensive matter, it is often necessary to combine the use of chemical disinfectants with such means as are taken for the removal of filth; and in the cases, which sometimes occur, where removal is for the time impossible or inexpedient, the filth should always be disinfected. Disinfection is likewise desirable for unpaved earth close to dwellings, if it be sodden with slops and filth. Generally, when cholera or typhoid fever occurs in a house or barracks, hospital or hut, the privies *especially* require to be disinfected.

A most remarkable illustration of the terrible effect of foul alleys in breeding pestilence is given by the veteran British sanitarian, Mr. Edwin Chadwick, who, in speaking of the efforts made to avert the last epidemic of cholera, remarked that, on inquiry into the course of cholera in the previous visitation, he found that it was very much upon the common

fever conditions. It did not visit all these fever-nests in towns and cities, but such as it did were visited with marked severity. Indeed, medical officers of experience, in the former visitation, foretold in which streets, and on what sides of the street, and in what houses it would again come, and this forecast was verified, even as to the rooms in some cases of particular houses. In the city of York, in the north part of England, we had one classical example presented of a particular court called the Hagworm's nest. The hagworm, it should be mentioned, is a species of worm infesting foul heaps of filth. According to local tradition, this court was the first spot visited by the black death, the first by the great plague, and the first by the sweating sickness. As it had remained unchanged in its unhygienic foulness during the lapse of centuries, inquiry was made whether it had remained true to its traditions during the cholera epidemic of 1832, and such was actually found to be the case.

4. All the sources of water- and of milk-supply should be most carefully and efficiently examined. Those which are in any way tainted with animal or vegetable refuse, above all, those in which there is any leakage or filtration from cess-pools, foul ditches, sewers, or drains, ought no longer to be made use of. Where the disease is cholera, diarrhoea, or typhoid fever, it is vitally necessary that none but the purest water should be drunk.

5. The washing and white-washing of uncleanly premises, including houses, huts, hospitals, barracks, guard-rooms, and the like, especially if they are densely or multifariously occupied, should be hastened with all practicable dispatch.

6. Over-crowding should be prevented. The sick-room should, as far as possible, be kept free from the presence of persons who are not of use or comfort to the patient.

7. The most ample ventilation should be enforced. Window-sash frames should be inspected, altered so as to open at the top and bottom if necessary, and when properly arranged seen to that they are *kept* sufficiently open. Especially when any kind of specific disease, communicable by infection of the air, has begun, it is essential, both for patients and for persons who are about them, that the sick-room, and the sick-house or hospital, be constantly and efficiently traversed by streams of fresh air. This is particularly necessary at nights, and steps should be taken to insure sufficient ventilation, even at some real or imaginary expense of comfort.

8. The cleanest domestic habits should be enjoined. Refuse material of any kind should never be allowed to remain, or even to linger, within the dwelling, hospital, barrack-room, or hut. Such refuse must be at once removed and safely disposed of. All utensils of every kind which require to be disinfected or cleansed should be attended to without delay.

9. With regard to material substances discharged or separated from the



bodies of the sick, special precautions of cleanliness and disinfection are necessary; indeed, the history of epidemics shows that sanitarians cannot be too much on their guard in this respect. Among discharges or substances separated from the body, which it is proper to treat as capable of communicating disease, are those which come in cases of small-pox from the affected skin, in cases of cholera and typhoid fever from the intestinal canal, in cases of diphtheria and scarlatina maligna from the nose and throat, and those exhalations from the skin and lungs which may saturate clothes; likewise in cases of eruptive fevers generally, measles, scarlatina, typhus, and so forth, when patients are convalescing, those emanations in any way freighted with the desquamation of the skin. The caution which is necessary with regard to such matters must, of course, extend to whatever may be imbued with them, in order that bedding, clothing, towels, and other articles which have been used by the sick do not become sources of mischief, either in the house to which they belong or in houses to which they are conveyed. Moreover, in typhoid fever and cholera, the evacuations should be regarded as capable of communicating a similarly specific and infectious property to any night soil with which they may be mingled in privies, drains, or cess-pools. This danger of multiplying the sources of communicating disease must be guarded against by the chemical destruction, decomposition, or disinfection of all the intestinal evacuations as soon as they are passed from the bowels, and certainly before they are thrown away, and so "let loose upon the world." Above all, they must never be cast where they can run or soak into sources of drinking water.

10. All reasonable care should be taken not to disseminate disease by the association unnecessarily of persons suffering from the specific communicable diseases, either with healthy persons, or in wards of hospitals where patients suffering with other diseases are being treated. This care is requisite not only with regard to the sick-house, ward, hospital, or ship, but likewise with regard to day-schools, places of public resort, courts of justice, and other locations where many different households are accustomed to meet. In this connection it would be well to remember that nurses and attendants should endeavor to avoid the patient's breath and the vapor from his discharges; that visitors must not go near the sick, nor even remain in the room with them longer than is absolutely necessary; they should not swallow their saliva, but clean the mouth and nostrils immediately after leaving the sick-room; lastly, no dependence must be placed upon vinegar, camphor, carbolic acid inhalers, and other supposed preventives, which, without attention to cleanliness and admission of fresh air, are not only useless, but by their strong smell render it impossible to perceive when the room is filled with bad air or noxious vapors.

11. Where dangerous conditions of residence cannot be promptly remedied, it will be best for the inmates, whilst still unattacked by the



disease, to remove to some safer lodging. If disease begins in houses where the invalid cannot be properly nursed and tended, it becomes an important question whether the risk of removing him to an infirmary or hospital shall not be accepted as the lesser evil of the two. In extreme cases special infirmaries may be necessary for the sick, or special houses or tents of refuge for the endangered. This method was largely and successfully resorted to in the Southern States during the terrible pestilence of yellow fever, in 1878.

12. In certain cases, peculiar medical arrangements are necessary; for instance, as cholera in temperate climates almost always begins somewhat gradually, in the comparatively tractable form of what is called "premonitory diarrhœa," it is essential that, where this complaint is epidemic, arrangements should be made for affording medical relief without a moment's delay to persons affected even slightly with looseness of the bowels. In the last visitation of cholera, the London letter-carriers were each furnished with a bottle of laudanum and lavender for immediate use when attacked, and the precaution resulted in great benefit. So, again, when small-pox is the prevailing disease, it is essential that all unvaccinated persons (unless they previously have had small-pox) should very promptly be vaccinated, and revaccination should be offered also both to persons above puberty who have not been vaccinated since childhood, and to younger persons whose marks or histories of vaccination are unsatisfactory.

Lastly. It is always very desirable that not only educated people, but as far as possible the populace likewise, should know what real precautions they can take against the disease which threatens them, what vigilance is needful in regard to its early symptoms, and what special arrangements, if any, have been made for placing gratuitous medical assistance within their reach. Especially in the case of small-pox and cholera, such information ought to be spread abroad by means of newspaper articles and printed bills or placards. In any case where the danger is great, house to house visitation, or personal inspection of all by discreet and competent persons, may be of the utmost service, both in quieting unreasonable alarm, or in leading or assisting the less educated and destitute parts of the community to do what is necessary for their safety.

It is hoped that every reader of this book, no matter how lofty his station in life may be, will realize that it is his interest as well as his duty to aid in promulgating, when the emergency arises of a serious epidemic among his poorer neighbors, this knowledge of how to avert its dangers, as well as to help them to practice the precautions here inculcated. Many a time has the Nemesis of scarlet fever, of diphtheria, or of typhoid, punished a rich man with the loss of a favorite son or daughter for culpable neglect of his poverty- and disease-stricken tenants, by the direct extension of a malady to his spacious mansion from some crowded and ill-ventilated tenement behind his alley-gate.

In houses and communities where proper hygienic conditions are unfulfilled, wide-spread diseases are almost certain sooner or later to be the result. Unquestionably those great and fatal epidemics which afflicted the cities of the Old World during the middle ages did not arise, as was formerly supposed, from such grand cosmical conditions as earthquakes, comets, mysteriously poisoned water and air, or still less from the anger of offended deities, but from simpler and more familiar household causes, being mainly due to overcrowding in faulty dwellings, to ill-planned, narrow, winding streets, a deficient water-supply, dirty clothes and houses, deficient removal of excreta and refuse, innutritious food, and frequent famines.

Fortunately, we are practically strangers to the extent and virulence of these old-time epidemics; but many of the diseases which still afflict communities are undoubtedly due to minor conditions of the same nature. These may arise from the house, town, or city being badly placed, the site being too low, like that of New Orleans, to permit of satisfactory ventilation and drainage, or from being situated on moist, malarious, or new-made and therefore unhealthy ground. Such is eminently the lesson of Memphis, Tennessee, which is full of warning to every community.

Most inhabitants of the United States remember the terrible fatality of yellow fever in that city during the summer of 1878, and when, in 1879, the pestilence reappeared in its limits, and was declared epidemic early in August, few thinking men or women failed to reflect that there must be some powerful local cause to account for the unusual prevalence and virulence of the disease in the first instance, and its exceptional recurrence in the second. As a result in part of this well-founded suspicion, a thorough inspection of the Bluff City was made, under the auspices of the National Board of Health, and the local cause which had so fearfully intensified the epidemic fully discovered. According to the report of the committee, the population of Memphis was about thirty thousand, the death-rate for the three years previous to 1878 was thirty-five per thousand, during the first yellow fever year it rose to one hundred and fourteen per thousand, and in 1879 it was fifty-one per thousand. Adjoining this record of frightful mortality, which even in the non-epidemic years was more than double that of Philadelphia in 1879, is found the statement that within the city limits were discovered six thousand cess-pools in use. These cess-pits were frequently shallow holes without any lining, and more than two-thirds of them were in dangerous proximity to living rooms, many being actually excavated in the cellars of occupied dwellings. Besides these cess-pools there was a large, probably an equal, number of disused but unemptied vaults, the contents of which were but scantily covered by a thin layer of ashes or refuse. In close juxtaposition to these leaky privy-vaults, which must necessarily contaminate the soil for fifty or a hundred feet around their margins, were situated nearly



three-fourths of the wells and cisterns which supplied the people of Memphis with a large part of the water (which is described as having a coffee or chocolate color) they consumed during their brief and feverish existence. No student of sanitary science can doubt that such an excessive death-rate and such an extraordinary degree of water-pollution stand to each other in the relation of effect and cause, and the proof, if any were needed, is found in the rapid improvement which has taken place in the health of the inhabitants since this cause of disease was diminished.

Such is the lesson of fever-stricken Memphis, but the same warning of preventable disease and death from polluted air or water is afforded by the sanitary history of a thousand small towns, ten thousand villages, and perhaps a hundred thousand farmhouses throughout our country. In fact, until public attention is fully awakened to this wide-spread danger of originating or aggravating epidemic disease, the philanthropist cannot too often reiterate the caution of a distinguished British hygienist, "that every case of typhoid fever should be looked upon by the owner or occupant of the house in which it occurs as an indication that something is wrong with the water-supply, or else with the method of disposing of the sewage," even if we do not approve the sterner sentence of another authority, "that for each death from typhoid fever somebody, meaning some plumber, architect, or sanitary engineer, *ought to be hanged.*"

### **Malaria as a Disturber of Health.**

The last of the great external causes of disease requiring notice in this place is malaria, a term applied to the as yet unknown cause of fever and ague. This subject of malaria is entitled to great attention, not only on account of its enormous prevalence in most parts of the United States, but also because its conditions of action have been so carefully studied, that our extensive knowledge of the habits of this poison to the human system can be very successfully applied for the prevention or abbreviation of the various maladies it produces.

The true origin of the poison in malaria, or marsh-miasm, as it is also called, has long been a matter of dispute. Prof. Aitken declares that in the absence of a better name it has been entitled malaria, and physicians have merely inferred the existence of such a poison, no exact knowledge having been yet obtained as to its nature and source. Several observers in our own country, and recently some noted Italian investigators, have laid claims to the discovery of the true cause of ague, in a low form of vegetable life, which Klebs and Tomassi Crudelli named the bacillus *malariae*. These latter experimenters even assert that they have infected rabbits with ague by injecting the spores or seeds of this bacillus into their blood. Their observations, however, although the experiments have been repeated in this country, are still unconfirmed, and their correctness, at least as regards the malarial fevers of the United States, must be considered at the present time as problematical.



The best general account of the characteristics of malaria, as observed in America, is to be found in Prof. George B. Wood's excellent work on the Practice of Medicine, from which the following is condensed :

In most parts of our country, but especially in those portions which form the beds of the Mississippi, Missouri, and Ohio rivers, it was found by the earliest settlers that when abundant vegetable decomposition accompanies occasional overflow of the soil, at a season when this decomposition is most rife, fevers of an intermittent or remittent type are exceedingly prevalent.

The circumstances which appear to be essential to the production of miasmata, as the atmospheric impurities, whatever they may be, are usually called, are heat, moisture, and vegetable decomposition. The peculiar morbid effects ascribed to this cause, and by which alone its existence can be recognized, seldom originate at a temperature under 60° Fahr., even though vegetable decomposition be going on. During the season of the year when the thermometer rises to upward of 80°, malarial or marsh fevers, liver diseases, neuralgia, and so forth, are very prevalent; but they are generally checked by the occurrence of frost. A certain continuance of the heat is not less necessary than a certain degree of it. Hence, miasmatic diseases seldom prevail beyond the fifty-sixth degree of latitude, because, though many days in summer may be very hot, the warm season is short. The nearer we approach to the equator, the more violent, as a general rule, do malarial complaints become, implying a greater intensity of the cause. Within the cooler portions of the temperate zones, they do not commonly make their appearance until the middle, and often not until the end, of summer.

Moisture (which is necessary to the evolution of malaria), if in excess, acts as a preventive, because surfaces deeply covered with water evolve less of the noxious effluvia than those which are but partially overflowed. Vegetable decomposition seems generally to be an indispensable factor in the production of miasmata. Hence, the banks of streams which from time to time overflow their borders, the margins of mill-ponds or canals, and the beds of lakes which have been drained, are especially unhealthy. Those who have time to study the pathetic as well as the ludicrous side of fever and ague, in a Mississippi region, should read the description of the town of Eden and its woe-begone inhabitants in Dickens' powerful novel of "Martin Chuzzlewit."

Water, either in the liquid state or in that of fog or vapor, appears to have a special affinity for the malarial poison, and has by some authors been supposed to directly dissolve it. There can be little doubt that exposure to the morning and evening dews of a miasmatic district, and especially their inhalation at night during sleep, is particularly dangerous. On the other hand, large masses of water seem to possess a protective power, as is shown by the fact that persons on board ship, and

those upon the sides of lakes opposite to the sources of exhalation, are less apt to be infected than those residing an equal distance by land, because the intervening water absorbs the miasm in its passage.

On account of this affinity of miasmata for moisture in the form of mist and fog, persons on low grounds are more exposed to sickness than those who live in elevated positions, and for the same reason lodgers on the upper floor of a house have sometimes escaped whilst those upon the ground floor were attacked.

Strong, prevailing winds carry the poison of intermittent fever to considerable distances, and on this account a mountain, a high hill, or a thick forest, which obstructs or deflects the current of air loaded with paludal exhalations, may insure complete immunity for the sheltered districts from this disease. A curious fact in connection with miasmata is, that the effluvia may be neutralized, decomposed, or in some other way rendered innocuous by the air of large cities. Malarious complaints may be quite prevalent in the outskirts and in the surrounding country, whilst individuals who remain in the thickly built up portions entirely escape. This fact is notorious in relation to the city of Rome, and is a matter of almost daily observation with physicians in Philadelphia.

Another noteworthy circumstance in connection with malarial diseases is, that by long exposure to the disturbing agency human organisms become less susceptible to the action of the poison. Hence, the natives of warm and tropical climates are much less frequently and less violently attacked with paludal fevers, than settlers or visitors from other lands. On the Mediterranean, along the coast of Africa, in the East Indies, in the West India Islands, and in our own Southern States, new-comers from northern latitudes are almost invariably attacked, and suffer much more severely from the fever than those who have been long in the country. It has also been noticed that those who, after residing in a territory and becoming acclimated where paludal fevers abound, have left it for a few years, discover a new susceptibility to attacks of the malady on their return within its baleful influence.

Although, as a general rule, marshes of considerable extent seem to be the favorite seats of the malarial poison, avoidance of low-lying, damp soils does not always give immunity from attacks of ague. Indeed, some of the facts recorded respecting the production of fever and ague tend to show that the only necessary condition is the development of a relatively small amount of fungous or algoid growth, and therefore lend powerful support to the germ-theory of disease as an explanation of the cause of malaria. Thus, for example, Friedel mentions that in a marine hospital near Stettin, a large day-ward was used for convalescents. As soon as any man had been in this ward for two or three days, he was attacked severely with tertian ague. In no other ward did this occur, and the origin of the fever was a mystery until, on close inspection, a large rain-



water cask, full of rotten leaves and brushwood, was found under the eaves of the hospital roof. This had overflowed and formed a stagnant marsh of from four to six feet square, close to the doors and windows of the room, which, on account of the hot weather, were kept open at night. Another remarkable instance is related by Dr. Holden, in which, on board of a ship at sea, eight cases of ague occurred apparently from the emanations from a large quantity of mould, which had formed in some closed store-rooms, exposed to the bilge-water in the hold of the vessel.

Unlike the contagious diseases, as small-pox, for example, the amount of the malarial poison received into the system apparently controls the severity of the attack of the disease. In some of the Northern States, the quantity or the intensity of the malarial influence is so minute that only a few persons suffer with ague or other malarial affections, and of these few, nearly all have light attacks; whilst in some of the Southern States, and on the west African coast, the malady is so severe that it frequently proves fatal in a two- or three-days' illness. Even further north than the Gulf States, it is the bane of all new settlers, and Dr. James Wilson graphically relates his experience, which shows how the undrained land is infectious with intermittent fever and the other malarial pestilences, to such an extent as to destroy many thousands of lives every year; so that in spite of constant immigration, extensive tracts of country continue as sparsely settled as ever, with very unhappy, very unhealthy people. Some part of this desert is the most fertile land in the country, and the most easily cultivated, but for the failure of health among those who undertake to occupy it.

In 1843, Dr. Wilson became acquainted with some men who had purchased tracts of this land very cheap—so cheap, in fact, that the crops of the first season more than paid for the land—but before Christmas one or more of each of their families were dead, and the rest were so broken down in health that no other good crop was ever raised by them. The migrations to this pestilential region are constant, so that on visiting the same section in 1868, a quarter of a century later, the doctor found the same desert, the same paradise of mosquitoes, the same kind of new emigrants, as hopeful as ever over their first luxuriant crop of peas and cucumbers, whilst older settlers bemoaned the loss of their relatives. It is best not to hint to these poor people that the locality is not the most healthy in the world, or some forlorn inhabitant may shoot you for abusing his country; discretion is much better than either dogmatism or argument on this subject until one gets well beyond musket-range. This emaciated patriot is perfectly sure that they have no sickness in his neighborhood but the chills, and everybody knows, he declares, *that* is no sign of an unhealthy country, for folks have the chills everywhere. People in such localities, indeed, often think a smart shake every second day is evidence of good



health, and in this they may, to a certain extent, be relatively correct, for a person having a regular tertian ague seems to be sometimes less likely to suffer from the more fatal forms of malarial disease.

The prophylaxis of malarial disease is as simple as that of escaping burns upon one's fingers from handling hot iron. Miasmatic regions should be avoided from the 1st of July until the occurrence of hard frost in the autumn. If, however, one is compelled to reside in or pass through such districts during the summer or fall, he should be especially careful to avoid the *evening, night, and early morning* air; the man who gets up at *five* being the last one to *thrive* under such circumstances. It is advisable to keep fires burning in the house where a person resides, and to sleep in the upper story. If necessarily exposed to night or early morning exhalations, never let it be when the stomach is empty, or after fatigue, or during exhaustion of any kind. Care should be taken, also, to guard against the intense heat of the sun in the middle of the day, and all kinds of excesses should be scrupulously shunned. The system ought never to be depressed by exposure to cold when over-heated, or by remaining long with wet feet or in wet clothes. During a forced residence in a malarial region the safest plan is to keep the system under a moderately strong influence of quinia or Peruvian bark, by the administration of six or eight grains of the sulphate of quinine daily, or to resort to arsenic as will be explained in its appropriate place.

## PART II.—CURATIVE MEDICINE.

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### INTRODUCTION.

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#### The Plan and Scope of the Subject.

IN this second part of the work, the author proposes to give an outline of the natural history of each disease, advice as to the modes of preventing its onset when threatened, recommendations as to its hygienic management, hints as to its probable course, fatality, and ultimate results upon the system, if recovery takes place, and finally suggestions in regard to its medical treatment. These last are appended more for the general information of the intelligent reader than for the purpose of teaching how to treat diseases, because, as so earnestly urged in the Introduction to Part I., the advantages of trained skill and experience are so great in the practice of medicine that no one but a thoroughly educated physician should ever take the responsibility of a human life or limb into his hands, if it can possibly be avoided. As advised on page 13, therefore, the most skillful physician who can be procured should be called in; but in the emergency, until he arrives, much can be done in accordance with the directions here given to allay the sufferings of the patient, to place him in a more favorable position for speedy recovery, and, above all, to prevent the calamity which has befallen him from becoming aggravated before the doctor comes, through want of proper care.

Since a large proportion of the "ills which flesh is heir to" are rarely seen in this country, and have therefore but little importance to inhabitants of the United States, except as matters of curiosity, it is proposed to give very brief notices of these infrequent maladies, in order to economize space for a fuller account of those prevalent diseases which, some time in their lives, will, alas, personally interest a majority of the readers of this book. On such occasions, the sufferer who consults these pages, eager to find out all that is known in regard to his complaint, will doubt-

less even after all be disappointed with the scantiness of our stock of medical knowledge, and the author tenders in advance his heartfelt sympathy in such disappointment, and his equally heartfelt wish and firm belief that, notwithstanding this ignorance, some of his suggestions, or the better ones of some brother practitioner of medicine, who is promptly called in to prescribe, and who can better judge of the medicinal and hygienic remedies applicable in each particular case, will mitigate pain, and contribute, at least, to a speedy cure. And after that cure is happily accomplished, let the remembrance of past suffering be a powerful incentive to the faithful study and practice of the precepts inculcated throughout the section on Hygiene in this volume, because it is far easier to preserve, by strict obedience to them, the prime blessing of health, than it is to regain that blessing when once lost in consequence of neglect or ignorance of sanitary requirements.

### The Classification of Disease.

Among the almost innumerable methods of classifying diseases which afflict the human family, one of the latest, and probably the best, is that devised by the Royal College of Physicians of England, and adopted by law as the basis for all those statistical reports relating to medical subjects of which the British nation is justly entitled to be proud. This, with some unimportant variations, is the system adhered to in the present section.

The plan of this nomenclature is to give an English name to the disease, employing the terms in popular use whenever they are not absolutely inaccurate, and to use only one word, or as few words as possible, in naming a disease. Definitions are attached to the English names in certain instances only, that is in cases where there might otherwise be some ambiguity in the signification of the title. The classification of diseases thus designated is based on their anatomical seat in the human body, the division being first into general diseases and local diseases.

The general diseases are those which affect the whole frame, and are subdivided into two sections. Section A comprehends those disorders which appear to involve a morbid state of the blood, and for the most part present the following characteristics: They run a definite course, are attended with fever, and frequently with eruptions on the skin; are more or less readily communicable from person to person, and possess the singular and important property of generally protecting those who suffer with them from a second attack; they are apt to occur as epidemics. Small-pox is a good example of this group, and in our ceaseless combat with disease it is with disorders of this section that hygiene and preventive medicine have won their grandest triumphs and accomplished their most beneficent work. Section B of the general diseases comprises for the most part maladies which are apt to invade different parts of the same body, simultaneously



or in succession. These disorders are sometimes spoken of as constitutional diseases, and they often manifest a tendency to transmission by inheritance. Gout and rheumatism furnish good illustrations of this type of disease.

The second class, that of local diseases, comprehends all those which affect the structure of special organs, or particular parts of the human body, leading to marked disturbance of their functions. Diseases of the eye, such as cataract, and local inflammations, such as pneumonia or inflammation of the lungs, exemplify the characters of this group. Owing to the wonderfully close association and sympathy between all the different parts of the human frame, no one organ can suffer alone, and hence with the local diseases constitutional disturbances, such as fever, generally arise, and may totally mislead an inexperienced observer. The recognition of local disease in obscure cases is often, indeed, one of the most difficult problems a physician can be called upon to solve. Commonly complaint of pain in some particular part directs attention to that spot as the seat of primary disturbance, and leads to its thorough examination, which should be made with the aid of all the mechanical appliances, such as the stethoscope, the microscope, the thermometer, and so forth, which medical science has placed at our disposal. It is only when after all these means are exhausted, in a vain effort to detect local disease at the seat of pain or of pronounced discomfort, sufficient to account for that disturbance, that we are justified in considering local distress as a mere symptom of general disease. Unfortunately, neither a general nor a local disease gives the sufferer any positive security against the onset of another malady at the same time, and we often see people burdened with a complication of disorders, each of which by its symptoms obscures the rest, and perhaps renders the proper treatment for them inadmissible. It is this tendency to the development of complications, either secondary to the chief disease or entirely independent of it, which in many affections is the indirect cause of death. Frequently, too, after a severe illness, some important organ is damaged in its structure, and the patient for the rest of his life suffers for want of its proper performance of function throughout his whole organism, which is really as much crippled in its work as a man would be if his leg or arm had been left upon a battle-field. This is especially the case with the heart after an attack of inflammatory rheumatism, which, by affecting the cardiac valves, prevents the circulation of the blood from being duly carried on, and, as it grows worse in later years, is apt to terminate existence abruptly by sudden death, or by the painful method of prolonged and lingering illness.

The greatest care must be exercised in portioning out the doses of medicines suggested for the treatment of the diseases described, and it should always be recollected that a mistake which is a mere blunder in other avocations may at any moment become a crime in the occupations of

prescribing, preparing, or administering medicines. Hence the doctor, the apothecary, and the nurse, who have always the life of the patient in their keeping, should be persons who are willing and able to fully realize their responsibility; those who, whilst *on duty*, are *unceasingly and vigilantly on guard* against committing an error of any kind.

The doses of medicines recommended in this section of the work are always for adults, unless otherwise expressly stated, and must be proportionately reduced for children according to age. Thus, for a young person of from fourteen to sixteen years, two-thirds of the ordinary dose should be given; from ten to thirteen, about one-half; from eight to ten, two-fifths; from six to eight, one-third; for a child of four or five years, one-fourth; for one of three years, one-fifth; for one of two years, one-seventh; for an infant of one year, one-thirteenth; and for a baby of from three to six months, one twenty-fourth. For example, the average dose of bromide of potassium for a grown person being twenty grains, that for a youth between fourteen and sixteen years would be sixteen grains; between ten and thirteen, ten grains; between eight and ten, eight grains; between six and eight, seven grains; between four and five years, five grains; at three years, four grains; at two years, three grains; at one year, a grain and a half; and at six months, three-quarters of a grain. These fractional amounts are most conveniently arranged for young children by diluting a single dose for an adult with the requisite number of tea-spoonfuls of pure water. That is to say, using the above illustration, if it is desired to administer bromide of potassium to a child one year old threatened with convulsions, twenty grains of the drug might be dissolved in thirteen tea-spoonfuls of water, and a tea-spoonful given every hour or two.

The doses of medicines vary, as already pointed out in the earlier part of this volume, in accordance with sex, idiosyncrasy, and habit, and one of the most important advantages enjoyed by a skilled family physician is his power, gained by long practical experience, of so adapting each dose of medicine to every individual of a family, as to gain the greatest amount of benefit with the least amount of injury in any particular case.

The general rule given above in regard to doses of medicines to children has some exceptions, the most important being in regard to opium, which is not well borne in childhood, and calomel or castor-oil, of which a larger proportionate quantity may be administered. In regard to the frequency of repetition of medicines, it should be understood that when not otherwise stated, this may be judged of by the effect produced. Thus, as a rule, an emetic may be repeated in fifteen minutes if the patient does not vomit; an opiate may be repeated in an hour if pain still continues without mitigation, and a cathartic in from six to eight hours if no purgative action is effected.

In those unfortunate patients who cannot take laudanum, morphia, or paregoric for the relief of pain, which constitutes the great symptom of

disease, codeia, chloral, hyoscyamus, bromide of potassium, Indian hemp, and lactucarium may be used as substitutes, but without much expectation that they will fully serve the purpose of opium, that greatest boon to suffering humanity.

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## CHAPTER V.

# THE ERUPTIVE DISEASES.

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### SMALL-POX OR VARIOLA.

Small-pox, the most remarkable of the eruptive fevers, is an extremely contagious affection, marked by an eruption over the body of pocks which contain matter or pus, and hence are called pustules. After a period of latency or incubation of from nine to twelve days, usually the latter, a remittent fever is established, followed by the characteristic eruption on the third day of the fever, or after about forty-eight hour's illness; this eruption sometimes appears upon the mucous membrane of the mouth and throat. On the skin the eruption passes through the stages of a papule or pimple, next a vesicle or little blister, then a pustule, and lastly a scab, leaving a mark or cicatrix where the scab has been. The disease generally remains in each of these stages about three days, so that the scabs begin to form about the ninth day after the pimples primarily appeared. As a rule, during the period of incubation, the patient shows no signs of the disease, and there are no means of knowing certainly whether an individual who has been exposed to the infection caught the disorder or not. When the incubation is complete, fever commences, with chills or repeated shivering fits, followed by sensations of great heat, high temperature, severe headache, vomiting, and intense pain in the back. There is often besides lassitude and general aching in the limbs, but the pain in the back is so peculiar and distressing that it is often considered the only ailment, and mistaken for a sprain or for an attack of rheumatism, for which relief is sought. It is, however, distinguished from the pain of lumbago by its being in the centre of the back, at its lower part, and also by being uninfluenced by movement. The pain in lumbago is situated in the large muscles on each side of the spine, and is greatly increased by bending the back. The continuance of vomiting after the



first few hours forbodes a severe form of the disease. There is usually much thirst and loss of appetite, the face is flushed, the tongue is coated, and the secretions of the mouth are slimy. On the evening of the third day after its commencement, the fever, called the primary fever of small-pox, is at its height, the eruption begins to come out, and what is known as the third stage commences. The eruption, which at first may often be felt beneath the skin as small, hard, shot-like lumps, rises up and becomes red in the form of a little pimple, and then gradually enlarges, ripening into a vesicle, which in its turn becomes a pustule filled with yellow matter or pus. The pimples first appear on the face, especially about the mouth and on the forehead, the neck and the wrists, then often not until the next day on the body, and lastly on the legs. In typical cases the pustules ripen about the eighth or ninth day after the pimples first appear, and some of them break so that the matter oozes out, and scabs or crusts are formed. Many of them, however, if not scratched open, dry up without breaking, and in about ten days more fall off, leaving a purplish red stain which slowly fades; or if the pustule has gone so deep as to destroy a portion of the true skin, there will be found to result the well known permanent disfigurement, and the unfortunate patient is pitted or pock-marked for life. On the appearance of the eruption the fever abates, the temperature falls nearly to the natural standard, the more urgent symptoms subside, and the pulse returns to its customary rate. The number of papules may vary from ten or fifteen up to many thousands, according to the severity of the case. The fourth stage, or that of secondary fever, commences with the formation of the pustules, or about the seventh or eighth day, and attains its height about the tenth or twelfth day. In those unprotected by vaccination, this period of secondary fever is often the most dangerous time of the disease. The important varieties of small-pox are the confluent, in which the pustules run together over the greater part of the body; the semi-confluent, in which they only run together here and there; distinct or discrete, in which all the pustules are separate; and abortive small-pox or varicelloid, in which there are comparatively few pustules, the general eruption scarcely passing beyond the vesicular stage. Besides these is occasionally seen the hemorrhagic or black small-pox, in which blood is poured into the vesicles or pustules, and there is a tendency to bleeding from the nose, throat, and gums. This is by far the most fatal form of the complaint, and from it few patients recover.

The diagnosis or recognition of small-pox is of great importance, and many an anxious hour is often passed by the physician, the patient, and the friends of the latter before it is possible to decide with certainty as to the nature of the disease. While small-pox may be mistaken for a number of affections, the chief difficulty after the eruption begins to come out is in distinguishing it from measles and from chicken-pox. Of course,

it is very important to make the diagnosis at the earliest possible moment, in order that timely precautions against the spreading of the disorder shall be instituted. After the pimples begin to contain fluid, the danger of mistaking the malady for measles is over, because the general eruption of measles is never vesicular, although a few little blisters are occasionally seen in bad cases. In many instances a probable opinion can be given that a disease is measles and not small-pox, from the fact that the eruption of pimples is softer, less shot-like, and arranged in obscurely-defined crescents upon the arms and neck. In others, however, it is impossible to decide before the second day of the eruption, when, as a rule, some few of the pimples will be found slightly vesicular if the disease is small-pox. When the vesicles appear, the great point of distinction between them and the vesicles of chicken-pox is that the small-pox vesicle is depressed in the middle, giving it what is called the umbilicated or navel-like aspect. This is an important characteristic, and should always be carefully looked for. Before the eruption comes out, only a probable guess can be made in many instances. Dr. Flint, perhaps the most acute diagnostician in America, says that decided fever following immediately after a chill, the fever continuing without much remission for two days, pain in the back being a prominent symptom, if it be known that the patient has been exposed to small-pox, or if this disease is prevalent, renders the diagnosis extremely probable. In comparatively rare cases, unusual symptoms in an attack of small-pox might for a day or two render the diagnosis difficult from scarlet fever, the simple mild fever called febricula, the skin disease called lichen, some of the pustular eruptions of the venereal disease, and in its very earliest stage from erysipelas and typhoid fever.

*Treatment.*—Since we have as yet discovered no antidote for the small-pox poison, the chief treatment is the relief of symptoms, as far as possible, as they arise, and careful nursing, in order to avoid needless aggravation of the disease or the development of complications. The mildest cases, as well as those which are more severe, should be kept in bed in a cool apartment, which is ventilated as freely as possible, without producing dangerous draughts. In bad cases the patient's back ought to be frequently examined, and suitable precautions taken against the formation of bed-sores, as recommended under the head of typhoid fever, and the hair cut off close, in order to avoid the matting with the corruption from the pustules when that begins to discharge. The bowels should be well opened as soon as fever develops with a table-spoonful of castor-oil, or a saline purgative, such as a Seidlitz powder or a bottle of citrate of magnesia, and then a cooling and diaphoretic mixture, composed of half a tea-spoonful of sweet spirits of nitre, ten grains of bromide of potassium, and five drops of laudanum, or the one thirty-second of a grain of morphia, administered every two or three hours if there is much pain or restless-



ness.\* After the primary fever subsides, with the coming out of the eruption, there are often a few days during which no medical treatment is necessary; but with the appearance of the secondary fever, the cooling mixture should be resumed, or ten grains of Dover's powder may be given at bed-time, and repeated in two hours if the patient is very wakeful or there is much delirium. To relieve the itching, which is sometimes almost intolerable, the surface of the skin may be sponged over with a weak solution of sulphurous acid or of carbolic acid, six or eight drops to the ounce of water. If no relief is obtained from these, anointing the body with cosmoline, or with simple ointment, may be tried; but it is sometimes needful to muffle the hands, especially of children, in order to prevent them from scratching open the pocks after they begin to heal, and so rendering the resulting scars much deeper and more permanent. It has been thought by some that keeping the patient in a dark room, or covering the face with a mask of mercurial or charcoal plaster, so as to shut it from the light, diminished the danger of being pock-marked; but these proceedings are of doubtful efficacy.

In malignant small-pox, which generally proves fatal, the face becomes so swollen that often by the end of the fifth day the eyelids are tightly closed. The throat also swells to such a degree that the patient may die from suffocation. Inflammation of the lungs, erysipelas, blood-poisoning, or perhaps Bright's disease of the kidneys are very apt to set in and hasten the fatal issue; and even if the sufferer escapes these, inflammation of the eye, the ear, or the glands of the groin are liable to occur, and leave the sufferer blind, deaf, or crippled for life.

To see a bad case of small-pox, the thick crust of eruption masking the entire face and head, the swollen, distorted features which render the person utterly unrecognizable, the closed eyes half glued together by matter, the puffed out, open, and dribbling mouth, and the swollen, nerveless, shaking hand all form a sight never to be forgotten, and whoever has seen this can see, except leprosy, few things more loathsome. And when it is also found that this disease is in the highest degree contagious, and is caught most readily from person to person, nothing is wanting to give it the first rank in the horrible incidents of human life. In members of races which are not accustomed to small-pox, or under certain unknown

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\* Where the services of a competent apothecary cannot be procured, this mixture may be prepared by putting into a tumbler four tea-spoonfuls of sweet spirits of nitre; eighty grains (or four scruples) of bromide of potassium; forty drops of laudanum; three table-spoonfuls of ginger or vanilla syrup; and four table-spoonfuls of pure water. The dose of this solution for an adult would be a table-spoonful repeated every two, three, or four hours, according to the urgency of the symptoms of feverishness, restlessness, and pain which it is intended to mitigate. For children, the quantity given must be proportionately smaller, as pointed out in the table already given. If morphia is used instead of laudanum, one-quarter of a grain will be the amount required in the above mixture, to furnish the proper dose in each table-spoonful of the liquid.



circumstances among ourselves, the disease appears to possess a peculiar virulence. Thus, for example, an entire troupe of eleven performing Esquimaux died of small-pox in France a few years since, nearly all before the eruption had time to make its appearance.

In malignant small-pox, and in the petechial or hemorrhagic form, the black small-pox of common language, the only chance of successful treatment is to support the strength with quinine in four-grain doses thrice daily, or Peruvian bark and other tonics, and with stimulants such as wine or brandy or milk-punch, in the forlorn hope that unusual vigor of the constitution may thus be reinforced long enough for the violence of the disease to become expended. If the patient can thus be kept alive until after the twelfth or fifteenth day without any important organ becoming seriously damaged in its structure, the chance of recovery will subsequently increase every day. The disease being self-limited, it is obviously our chief duty, in the absence of any known specific, to direct all our energies towards sustaining the patient's strength in his battle with the disorder, and the prospect of recovery, or prognosis, as it is termed, turns upon the relative power of endurance of the disease-poison and the patient's constitution.

*Diet.*—The diet in the early stage of small-pox, like that in most febrile conditions, should be light and unstimulating, consisting of rice, corn-starch, bread and milk, or arrow-root. Oranges or lemonade in moderation may be allowed, unless there is a tendency to diarrhoea. Ice-water, lumps of ice, or iced carbonic acid water in small quantities at a time, may be frequently repeated. Later on in the disorder, when the strength begins to fail and the pulse grows weaker, strong animal broths, beef-essence, and other highly nutritious aliments are necessary: and if the pulse at the wrist should seem very feeble, and especially if it should become intermittent, milk-punch, egg-nogg, or other powerful stimulants ought to be resorted to.

*Nursing in Small-Pox.*—The general care of a small-pox patient ought to be afforded in accordance with directions contained in the chapter on Nursing, and most of the special precautions for avoiding the extension of the disease, and so forth, have been pointed out in the article on Contagious Influence (see page 289). On account of the danger of pneumonia and pleurisy, particular watchfulness is needed against taking cold from draughts of air, and during the delirium of the fourth stage, in bad cases, the attendant must be constantly on guard to prevent the patient from injuring himself or others.

### Vaccination the Great Preventive of Small-Pox.

Seeing, then, that small-pox is a most painful, loathsome, and fatal disease, for which we have no cure, it becomes infinitely important to avail ourselves of the protection against its ravages afforded by Dr. Jenner's

beneficent discovery of vaccination, a discovery which ought to make his name honorable whilst the world stands.

And yet, strange to say, there are people bearing the general aspect of reasoning beings who oppose vaccination; and in England, where vaccination has been made compulsory by law, a league has been formed to combat its enforcement. Recently the folly of these fanatics met, it is stated, with a most righteous punishment in the following circumstance: A leading anti-vaccinationist, Escott by name, who refused to have any of his children vaccinated, lately lost two of them and his wife by small-pox. Escott borrowed a suit of clothes from a friend to attend his wife's funeral, and returned them without disinfection, with the result that the lender caught small-pox and also died of it. Subsequently nearly every house in the neighborhood was infected, producing a local epidemic of small-pox, during which sixteen patients were removed to the pest-house. The only excuse for the obstinacy of such deluded people is, that more than half a century of deliverance from the horrors of small-pox has rendered most persons practically ignorant of its dangers. In the latter half of the eighteenth century, that is, from 1750 to 1800, small-pox attacked almost every inhabitant of England, and about one out of every five seized with it died, whilst nearly another fifth of its victims were disfigured or crippled for life. It is estimated that two-thirds of the blind people in England at that time lost their sight from small-pox. To give an idea of its relative mortality, Dr. Guy states that it caused eighteen per cent. of all the deaths, and was one hundred times as fatal as diarrhœa, with its allied intestinal disorders, and six times as fatal as apoplexy, palsy, and sudden death taken together.

The objections to vaccination, aside from the mere sentimental ones, are that in some instances erysipelas and venereal disease have been apparently caused by it, and that it has been accused of being the means of inoculating the human system with scrofula, consumption, and certain cutaneous affections. Now, although most of these objections can be removed by the use of what is called bovine virus, obtained direct from the cow, without ever having passed through any human body, even granting that vaccination is in a few cases, say once in ten thousand times, dangerous, how much wiser are we to choose it, as the lesser evil, instead of the almost inevitable greater misfortune of small-pox, from which one out of every five die, and another one out of the surviving four is disfigured for life. Let any reader try to imagine what would be the aspect of affairs in his own neighborhood, if deprived of the blessings of Jenner's great discovery, when two out of every five people he knows would either die or be rendered permanently repulsive by small-pox, contrasting it with the present condition of society, in which few, if any, of his acquaintances positively know of a single person who has been unmistakably injured by vaccination.

The duty of vaccination is rendered far more imperative by the danger which every unprotected person in a community exposes his neighbors to by becoming the starting-point of an epidemic of small-pox. Hence, although a man may have the privilege of thus trifling with his own life and health, he has no right to imperil others by his perversity or ignorance; and the good of society, which is a higher law than that of personal liberty, demands that compulsory vaccination be legally established, as it is hoped it will be ere many years elapse. Even before that is done, however, if every parent or guardian under whose roof dwells an unvaccinated child could be brought to realize the life-long sorrow which they must feel should that dear, innocent baby-face be forever scarred and disfigured, simply in consequence of their culpable neglect to have it protected by vaccination, we might soon hope to see the curse of small-pox "stamped out" from the face of the earth. (For details in regard to vaccination, see the next article.)

### COW-POX OR THE VACCINE-DISEASE.

This disease, called *Vaccina* in medical books, is induced in the human being by the process of vaccination, either accidentally, as in the case of the young milkmaid who led Dr. Jenner to his grand discovery, or, as is usual nowadays, by being rubbed into a slight wound made for the purpose. It is apparently a modified form of small-pox, in which a cow-pox vesicle on the udder of a cow or heifer is the common original source of the infecting matter. The disease is attended, as a rule, with no further eruption than the vesicle, ripening into a pustule at the point or points where the matter is inoculated. It is communicable by inoculation, but not by the other ordinary modes of infection, mild in its course, and yet, generally speaking, protective against small-pox. The period of incubation is from two to four days, and the height of the disease is reached on the eighth or the ninth day. The cow-pox papule or pimple, on the third day after the virus has been inoculated, is in typical cases very similar to the papules of genuine small-pox as they appear on the third day after the primary fever commences, and it goes through the same stages, with about the same rapidity, becoming a vesicle, then a pustule, drying up on the tenth or twelfth day into a scab, which usually falls off during the third week. The scar which is left is peculiar, and generally characteristic. It is marked by a number of distinct though minute pits over the surface where the scab has been, and these constitute the evidence of a successful vaccination. During the development of this single pock, the adjoining lymphatic glands, generally those of the armpit, swell, and a feverish state is induced, with thirst, hot skin, and quickened pulse. Sometimes a slight eruption appears over the body, and in rare instances this is for a day or two composed of small pimples or vesi-



cles, which, however, soon fade away without leaving any trace of their presence.

The operation of vaccination is by no means so simple and unimportant as it seems at first sight, and it therefore ought always to be performed by a physician. If done with human virus, it is usual to crush a fragment about the size of a pin's head of the crust from a healthy child between two pieces of window-glass; mix this into a paste with water, and spread it upon a spot upon a child's arm, a little below the shoulder, where a number of very slight cuts, crossing each other, have been made with a sharp lancet. The paste should be worked in these little wounds with the point of the instrument, and allowed to dry before being rubbed with the clothing. It is better not to cut so deep as to cause much of a flow of blood, lest this fluid should wash the virus out of the incisions. The usual place for vaccinating is on the outside of the arm, an inch or two below the shoulder; but if the operation fails here, as is sometimes the case after repeated trials, an attempt may be made on the outside of the thigh, just above the knee. Vaccination should be performed on all children between the ages of one and three months, unless some special reason exists for its postponement, and it is recommended to insert the virus in four or five places close together, so as to produce several pustules, although, by a majority of physicians in this country, one pock is thought sufficient. Revaccination should be performed about once in seven years, as in some instances the protection afforded appears to wear out in that time; and, as there is no means of recognizing them, the safer way is to renew the vaccination.

The animal or bovine virus is supplied from carefully vaccinated calves by a number of producers in various parts of the country. It is usually furnished on little ivory points, shaped like a lancet-blade, or on pieces of quills. Either of these is to be moistened in pure water, and then rubbed on a lightly scarified surface, prepared as already described. The bovine virus is apt to make a very sore arm, but has the great advantage of avoiding all possibility of introducing the horrible poison of venereal disease into the blood of the infant operated upon.

### VARIOLOID.

Varioloid is the name given to the modified small-pox which arises in persons who, having been imperfectly vaccinated, or having allowed the protection to become exhausted before revaccination, are but partially secured. The primary symptoms of an attack of varioloid are sometimes as severe as those of genuine small-pox, but after the vesicular stage is reached the disease seems to be cut short or aborted, so that the vesicles dry up, as a general rule, without becoming pustules, and, of course, none of the dangerous secondary fever occurs. Hence, the protection afforded

by vaccination, even when carelessly allowed nearly to run out, is yet sufficient to preserve the life, and prevent the disfigurement of the patient in most cases. It is very important to make the diagnosis of varioloid from chicken-pox, because the mildest case of the former may give rise to virulent small-pox in an unprotected person, and so originate an epidemic. The chief points to be relied upon in making the distinction are the abrupt subsidence of the fever when the eruption comes out, the presence of eruptive points in the mouth and throat, and generally the existence of a few umbilicated vesicles in varioloid; but instances sometimes occur in which the diagnosis is extremely difficult, or for the time impossible. In doubtful cases, where there is any ground to suspect that the malady is varioloid, it is best to act on that suspicion, isolating the patient, and vaccinating all who have been exposed to the contagion. As the period of incubation is much shorter for inoculated cow-pox than for small-pox acquired in the usual way, vaccination should never be neglected, even if several days have elapsed after exposure to the more dangerous disease before it can be performed, in the hope that the milder may overtake and disarm the graver disorder.

The medical treatment, diet, and nursing suitable in varioloid are precisely similar to those directed in small-pox, and for vaccination, except in rare instances, nothing but ordinary care is required.

### CHICKEN-POX OR VARICELLA.

This is one of the frequent diseases of childhood, and consists of an eruption of vesicles, similar in some respects to those of small-pox, but rarely becoming pustular and never umbilicated. These vesicles often come out in successive crops, are rather sparsely scattered over the body, and do not usually leave pits or scars after they heal. The disease is attended with some fever, but is rarely fatal. It is not prevented by vaccination nor by small-pox, and does not have any protective influence against these diseases. The period of incubation is from four to twelve days, varying more widely than in the more serious eruptive maladies hitherto described. Chicken-pox is a very contagious disease, and is therefore generally seen in childhood, although it is sometimes met with in adults, and is then occasionally with great difficulty distinguished, if the patient is not seen at the beginning of the attack, and before the vesicles have been burst by scratching or rubbing. At the commencement, in marked cases, the patient's body looks as if it had been sprinkled with boiling water, each drop of which had raised a tiny blister upon the skin; and as these develop rapidly, often in twelve hours from the papular stage, never have a central depression, and when broken empty themselves at once, instead of draining away a little at a time, as the small-pox vesicles do, in consequence of their being divided up by internal partitions into a

number of little cavities, careful observation will generally prevent a serious mistake. That great watchfulness should be exercised is proved by the circumstance that several local epidemics of considerable severity have been traced to cases of varioloid which were erroneously pronounced chicken-pox, and allowed to spread the infection unchecked, until time revealed the terrible blunder which had been committed. Dr. Flint declares that if the first efflorescence of the eruption be observed in a suspicious case, the fact that the papules for some hours precede the vesicles, establishes the diagnosis in favor of varioloid.

*Treatment.*—The treatment of chicken-pox is chiefly hygienic, comprising rest in bed in a cool room, confinement to a light, unstimulating diet, and abstinence from animal food. If the fever runs high, a cooling mixture, such as that recommended in the first stage of small-pox, may be administered, and if the restlessness at night is very great, an anodyne, such as three grains of Dover's powder for a child of five years old, may be necessary. Constipation ought to be avoided by the use of saline laxatives, and should the patient seem debilitated after the disorder subsides, much benefit may be derived from the tonic influence of quinine, nux vomica, and iron.

### MEASLES OR MORBILLI.

Measles is a contagious eruptive disease, formerly following very strictly the usual rule of the eruptive fevers, and rarely occurring a second time after childhood. Of late years, however, by one of those curious changes to which epidemic influence is subject, second attacks of an unmitigated type have become comparatively common. After a period of latency or incubation, of about fourteen days, a continued fever commences suddenly, with or without a slight chill, attended with cough, swollen, watery eyes, and sneezing, almost precisely as if the patient had taken an ordinary cold. In severe cases there is apt to be some vomiting, and on the second day the features may appear swelled, with decided redness across the nose and upper part of the cheeks, but the peculiar eruption is tardy in making its appearance, often not coming out until the fourth day after the commencement of the febrile symptoms. When developed this eruption is made up of small, soft papules, often exhibiting the exact tint of a red raspberry, and here and there upon the arms and neck, arranged in imperfect and rather obscure crescents, which, however, are very characteristic of the malady. These pimples are but slightly elevated above the surrounding surface, give none of the feeling of shot-like hardness to the touch which is indicative of the small-pox papule, and temporarily disappear under firm pressure. They make their appearance first on the forehead and temples, and extend over the face and neck in a few hours, but the further advance over the body and limbs is quite gradual, and often occupies a couple of days. The fever does not subside with the appear-



ance of the papules, but on the contrary frequently increases, thus showing a marked contrast to small-pox. This fact is worthy of remembrance as being of value from a diagnostic point of view. The eruption, which ends in slight itching and desquamation, usually begins to fade at the end of the fourth or during the fifth day after it first appeared, and at the same time the fever, cough, and other catarrhal symptoms subside, often with very satisfactory rapidity. In rather severe cases the throat may become quite sore, and troublesome diarrhœa may occur, both of these disturbances being the results of an irritation on the lining of the alimentary canal, similar to the more decided disturbance of the pulmonary mucous membrane and of the skin.

If, when the eruption commences to fade, the fever does not subside and the cough continues troublesome, the case is a serious one, and there is great danger that bronchitis or inflammation of the lungs will come on. This is most apt to occur in winter, but is at all times of the year the chief danger of measles. Should the respiration be seriously interfered with, the blood, being imperfectly supplied with oxygen, fails to circulate properly, and, settling in the declining papules of the eruption, gives them a dark-purple or even a blackish hue. In this way are produced the cases which have received the popular name of "black measles." In weakly children, or after unusually severe attacks, cough may remain for weeks or even months; and, if there is a predisposition to consumption, will often appear to be the starting-point of that malady.

The diagnosis of measles must sometimes be made from a common cold, from influenza, from the early eruption of typhus fever and of small-pox, from scarlet fever, venereal disease, and from common flea-bites. From several of these it is usually distinguished with ease, if the possibility of its being confounded with them is carefully considered; but in regard to small-pox and scarlet fever, it is sometimes necessary to suspend judgment for twelve or twenty-four hours, until the characteristics of the eruption become better defined. As suggested when speaking of chicken-pox, in doubtful cases it is best to err on the side of safety, and enforce isolation, and vaccination of those exposed to the danger, should the attack prove to be the more serious disease.

Next to the peril of some grave pulmonary disorder resulting from an attack of measles, is the risk of injury to the organs of vision by the production of that obstinate affection called granular eye-lids, which, however, can usually be avoided by proper precautions in nursing during the attack. Aside from these two dangers, measles among healthy children, at a favorable season of the year and under proper treatment and good nursing, is practically of little importance, and the plan adopted by many parents, of allowing their children to take the infection, is by no means injudicious, if the advantageous conditions enumerated above can be secured. But when there is a predisposition to consumption or

scrofula in a family, or the child suffers from any disease of the eyes, or even a weakness of the organs of vision, strenuous efforts ought to be made to protect him from contracting the disorder.

*Treatment.*—The treatment of measles in mild cases and those of moderate severity consists in confinement to bed in a darkened room, which, whilst well ventilated, is very carefully arranged so as to avoid the access of draughts of air to the patient. If the fever runs high, a cooling mixture, as advised on page 310, should be administered, but in proportionately small doses; and if the cough is very troublesome, a combination of five drops of ipecacuanha wine and forty drops of syrup of squills with twenty drops of paregoric every two, three, or four hours will often prove exceedingly useful. On account of the tendency to diarrhoea, which, if once excited by purgatives, sometimes runs on until dangerous debility is produced, even laxatives had better be avoided for the first few days of the attack, save in exceptional instances. The inhalation of warm vapor from the spout of a tea-kettle will often serve to allay troublesome cough, and, after the eruption is fairly out, dryness and heat of the skin may be much relieved by sponging with cool or tepid water. It is probable that the popular dread of driving in the eruption by cool applications has little foundation in fact. When desquamation and itching commence, anointing the whole body two or three times daily with vaseline, oil, or fresh, that is, unsalted lard, is productive of great comfort. If diarrhoea comes on and is at all profuse, it ought to be promptly checked, but not stopped too quickly, with five drops of laudanum and astringents, such as half a tea-spoonful of the aromatic syrup of galls, repeated every two or three hours. In cases of black or malignant measles, quinine in full doses and alcoholic stimulants given freely or even largely, with nourishing soups, beef-tea, eggs beaten up with milk, and so forth, afford the best chance of success. If debility continues, tonics must be early resorted to.

*Diet.*—The diet of a patient suffering with measles should, from the very commencement of the attack, be watched with great care, on account of danger that any imprudence in the direction of eating unsuitable food may bring on intractable diarrhoea. On this account boiled milk is preferable, and toast or boiled rice should be substituted for potatoes and other vegetables. Fruits ought not to be allowed, without the express orders of the physician in attendance, until after the period of peril from disturbance of the bowels is terminated.

*Nursing.*—The nursing of a patient with measles is also a matter of great importance, and the two prominent dangers of the complaint, namely, obstinate or fatal pulmonary disease from taking cold, and permanent injury to the sight from over-stimulation of the eyes in their irritable condition by an excessive amount of light, ought to be constantly kept in view. The instructions given in an earlier chapter of this volume, in regard to

obviating the dangers of cold and cold air as causes of disease, must be faithfully carried out. It should not be forgotten that, after the fever remits, and the skin begins to be covered with a pleasant moisture, there is far more risk of taking cold from draughts of cold air, from contact with moisture, or even from throwing off the bedclothes, or sitting up with the limbs imperfectly protected, or the feet clad in slippers only, than when the cutaneous surface is hot and dry. In regard to care of the eyes, not only should the room be darkened, but the window opposite the bed should be carefully screened by a thick curtain, so as to give the organs of vision a complete rest from their usual stimulus, and no reading, writing, or sewing should be allowed until convalescence is completely established.

### GERMAN MEASLES OR RUBEOLA.

This is a mild contagious affection, very similar in many respects to ordinary measles, but apparently differing from it, because neither disease affords any protection from the other. Hence it is probable that frequently people who are supposed to have suffered from measles twice have, in reality, on one of the occasions, been the subjects of German measles. The disease is also called R  theln and French measles, or bastard measles, and the chief difference between it and morbilli is, that the fever is usually less intense, the irritation of the eyes less severe, and the cough and other bronchial symptoms less troublesome. The color of the eruption is rather more of a rose-tint, the pimples are round instead of oval, and the crescentic arrangement is wanting or extremely obscure. Children are chiefly affected with German measles, although it also occurs after adult age is attained, but in any case the malady is so slight that the patients rarely feel sick enough to keep in bed, and no instances of death from the uncomplicated affection are recorded. Its chief importance, then, lies in the errors of diagnosis to which it might lead; and, as it is only likely to be mistaken for mild cases of scarlet fever or genuine measles, even these are of no great moment. The absence of vomiting, pain in the back, and preliminary chill would almost always suffice to exclude the possibility of small-pox or varioloid.

The treatment, diet, and nursing appropriate to German measles are the same as those recommended in the ordinary form, in the few cases where any special care is needed.

### SCARLET FEVER OR SCARLATINA.

Scarlatina, called also scarlet rash, is a very contagious and, in some epidemics, a very fatal disease, chiefly affecting children, although adults are not exempt from it. It is characterized by a universal red rash, with



high fever, strawberry tongue, and redness with sometimes ulceration of the throat. The fever begins after a very short period of latency, of sometimes only a day or two, though generally varying from four to nine days; and about the second day of the fever, or sometimes later, a scarlet efflorescence appears in the back part of the throat and on the neck and face. This eruption gradually spreads over the body and limbs, and in favorable cases fades away on the fourth or fifth day, disappearing by the seventh or eighth, and being followed by desquamation or peeling off of the skin, which is sometimes very profuse. The inflammation of the throat may be very severe, and in bad cases extend to the glands of the neck and below the jaw, which may become enormously swollen. The kidneys are apt to suffer from congestion or inflammation, attended with the appearance of albumen in the urine and of dropsy, which not infrequently proves fatal.

Scarlatina, which is merely the Latin name for scarlet fever, and does not denote any milder form of the disease, begins with weariness, lassitude, and depression, or a feeling of sickness at the stomach and general discomfort. Then follow shivering and headache, pains in the back and loins, vomiting, and coated tongue, similar very frequently to what is seen in other eruptive diseases, and it is often not until sore throat begins, and the skin of the neck and face becomes of a bright-red color, that the malady is suspected of being that dreaded complaint, scarlet fever. In many instances the onset of the attack is with severe vomiting, which is apt to continue for twenty-four or even forty-eight hours, and very soon the child complains of its throat feeling sore. There is no remission of the fever when the eruption makes its appearance, but on the contrary it continues high as long as the minute pimples remain out and any inflammation of the throat persists. In this complaint there is apt to be a very great disturbance of the nervous system, indicated by great depression of the mental and physical powers, a failure of the latter occasionally so great as to cause death before any cutaneous eruption or throat affection has time to appear. Indeed, death has been known to occur within six hours from the time the fever first commenced. Such cases apparently die from paralysis of the heart, perhaps as in sunstroke, from the intense heat of the blood circulating through it. The eruption of scarlet fever consists of small bright-red spots, less than half the size of those found in measles, irregularly grouped, and separated by vacant spaces of healthy skin. Very soon, however, these scarlet dots run together, so that in a few hours the redness becomes general over considerable portions of the cutaneous surface, and in severe cases the whole body may present the appearance of a boiled lobster. The color of the eruption is generally brighter in the hollows of the knees and elbows, and about the armpits and hips, than at other points. It disappears under the pressure of the fingers, and reappears from the edge to the centre, after the pressure

is removed. In some instances the eruption may make its appearance upon the limbs before it shows itself upon the neck and face. When it begins in the usual way upon the neck and face, it commonly shows first on the forehead and temples, leaving the skin about the mouth for a time unaffected. This peculiarity is worthy of note, because it aids in distinguishing the disease from small-pox.

Certain symptoms assist in the diagnosis of the fever of scarlatina from that of the maladies which resemble it. The pulse is small, weak, and rapid, often running from one hundred and twenty to one hundred and forty beats per minute; the heat of the skin is very intense, attaining a height of  $105^{\circ}$  or  $107^{\circ}$  Fahrenheit, as tested by a thermometer in the armpit. Generally, in uncomplicated cases, the higher the temperature the more serious the attack, especially if the eruption be very abundant, and still more so if it be suppressed. The greatest heat is developed much more rapidly than in other febrile affections, and this is also frequently an important diagnostic point. The appearance of the tongue is often quite characteristic; the papillæ are singularly elongated and enlarged, so as to stand up in an erect position, and they appear of a deep-scarlet color, very prominent amidst the thick, white, creamy fur which coats the surface of the organ, causing it to present the aspect of having been sprinkled with coarse red pepper. This is what is called the strawberry tongue of scarlet fever, and it is so peculiar that, when well marked, the disease can almost be recognized by it alone, without examining any of the other symptoms. The tip of the tongue has commonly the same vivid red color seen in the papillæ scattered over its general surface. As there is in scarlet fever a great tendency to the development of Bright's disease of the kidneys, the condition of the urine should be carefully examined in all cases, particularly during the period of convalescence. After the fifth day of the eruption, the peeling off or desquamation of the general surface of the body ought to commence, and may continue for one, two, or even more weeks, and throughout this whole period especial care is needed to guard the patient against taking cold, which is peculiarly liable to settle upon the kidneys and result in an attack of Bright's disease, which frequently proves fatal. When this dangerous complication does set in, as occurs notably oftener after a mild than after a severe attack of the fever, about the end of the third week, the unfavorable symptoms of scantiness of the urine, which on testing by heating is found to grow milky from the presence of albumen, and of dropsy, make their appearance. Dropsical symptoms may first show themselves by slight puffiness of the eyelids, and the skin of the cheeks just beneath the eyes, then the hands and feet swell, and general dropsy or effusion of serum from the blood into the subcutaneous tissues comes on.

The varieties of scarlatina are three in number, and differ very much in their severity and danger to life. In the first form, which is called sim-



ple scarlet fever, there is a scarlet eruption, with moderately high fever, and some redness and soreness of the throat, but without ulceration. Anginose scarlet fever, the second variety, is a more severe type, with redness and ulceration of the throat, and a tendency to formation of abscess in the neck, in consequence of implication of the submaxillary and cervical glands. In the third form of malignant scarlet fever, the ulceration of the throat is so violent that a tendency to mortification or sloughing, as it is called, soon develops. In the worst cases, the scarlet rash is scarcely if at all visible, petechiæ or blood-spots, such as are seen in typhus fever, make their appearance, and the fever is of a low variety, tending rapidly to great prostration, and death from exhaustion. It must be remembered also that scarlet fever occurs without any rash or sore throat being observed; but even then, as in all other cases, it is a treacherous and deceitful disease. The mildest cases, which seem perfectly innocent in themselves, are, it is thought, especially apt to be followed, perhaps only after the lapse of weeks, by disease of the kidneys or by rheumatism; or, as sometimes happens, an attack in which the fever is only moderate, and the throat but little sore, may suddenly develop into the anginose variety, and prove rapidly fatal, in spite of all that medical treatment can accomplish for the relief of the little sufferer. The fatality in some epidemics is so great that it has sometimes been called the English pestilence; but under ordinary circumstances the death-rate is not more than ten or fifteen per cent. of all the cases attacked. It affects males and females about equally, and infants under one year are by no means exempt from its ravages. It is generally believed that the differences in the violence of the disease are due to constitutional peculiarities in the patients, so that the most malignant form may be developed out of contagion derived from the mildest case. Groups of mild cases, occurring successively in different families, give some hope, however, that we may yet discover a permanently mild variety, which can be used, like vaccination is in regard to small-pox, as a protection against the dangerous forms of the complaint. Indeed, the researches of Dr. Pasteur, who has lately become so famous by his success in preventing the occurrence of the disease called anthrax or splenic fever in sheep, leads us to anticipate some wonderful discoveries in respect to methods for mitigating or attenuating the virus of disease-poisons of all the eruptive maladies in the next few years.

The diagnosis of scarlet fever has to be made from small-pox, measles, German measles, diphtheria, and nettle-rash; occasionally from typhoid fever and from erysipelas. The distinction of scarlatina from small-pox rests on the absence of the shot-like hardness of the papules, the rapidity with which the eruption spreads over the body, the continuance of the fever after the papules begin to appear, the strawberry tongue, and the comparative slightness of the pain in the back. On the second, or at furthest the third day, the absence of any umbilicated vesicles settles the



question beyond all doubt. The earlier diagnosis from measles depends, in addition to the peculiarities just referred to, upon the absence of sneezing, discharge from the nose, and wateriness of the eyes, also of the obscurely crescentic arrangement of the papules. The absence of high fever, great heat of skin, and of vomiting, in German measles, will generally prevent error, and the intense itching which characterizes nettle-rash from the first outbreak, as well the elevation of the patches of eruption, and their being whiter near the middle than at the margin, will commonly serve to distinguish the troublesome but unimportant cutaneous affection. Since there sometimes appears in diphtheria an eruption so closely resembling that of scarlet fever that it has received the name of scarlatiniform, it is occasionally difficult, or even impossible, to distinguish a case of scarlatina from one of diphtheria in the earlier stages; but, as a general rule, the lesser amount of fever, the severe prostration of strength, and the absence or scantiness of eruption, enable an attentive observer to discriminate diphtheria from scarlatina. The diagnosis before the eruption appears can never be made with certainty; but if a child which has been exposed to the contagion of scarlet fever is at any time after the next two, and before the end of the next ten days, suddenly seized with obstinate vomiting, followed by fever with great heat of skin, sore throat, without cough or watering from the nose and at the eyes, the chances are very great that the malady is scarlatina.

Among the most important sequels of scarlet fever are Bright's disease and rheumatism, as already mentioned, and inflammation of the middle ear, which, if not properly attended to, in due time is apt to result in bursting of the membrane of the drum of the ear, and serious impairment or even total loss of hearing.

*Treatment.*—Having, unfortunately, no specific for scarlet fever, treatment must be chiefly for the purpose of relieving the symptoms of the disease. The fever-mixture already recommended, and, in cases where the throat is much affected, chlorate of potash in five-grain doses, each dissolved in a table-spoonful of water, and repeated every three hours, should be administered in the early stage, and later on, in severe cases, tonics and stimulants are very important. As an external counter-irritant to the throat, where there is much soreness internally, and especially in the anginous variety, Prof. Flint endorses the application of a slice of salt pork, sprinkled with salt, or salt and powdered camphor, as being highly beneficial. Where the bodily temperature is very high, and there appears to be danger of hopeless prostration from failure in the power of the heart or from stupor, it is advisable to try the cool bath or cold pack, or even sponging with cold water, which is usually exceedingly grateful to the patient. The danger of taking cold is to be carefully guarded against by drying the body as soon as the temperature, as shown by the thermometer, is reduced to within one or two degrees of the natural standard of

98.4°. After the troublesome itching commences, the skin should be anointed twice daily with vaseline, lard, or suet, which, beside allaying the irritation, has the further advantage of tending to prevent the dissemination of fragments of the skin freighted with disease-germs. The treatment for the disease of the kidneys and resulting dropsy will be considered under the head of Bright's Disease, which see. The inflammation of the ear, which so often causes deafness if not duly attended to, can commonly be prevented from doing serious damage to the organ of hearing, by puncturing the membrane of the drum and letting out the contained pus as soon as it is fully developed. In order to perform this little operation at the right time, the ears of patients ill with scarlet fever ought to be examined every day, if the person is very sick, and it is feared that he is too ill or too overcome with stupor to notice and complain of the pain of suppuration.

*Diet.*—The diet in the early stage of scarlet fever requires little attention, because, as a rule, there is so much sickness of the stomach that scarcely any food is either desired or endured. Uneasiness need not be felt if the patient partakes of no food at all for forty-eight or sixty hours, except a little milk and lime-water, and it is probable nature's intimation that she does not want any aliment put into the stomach may be strictly respected with advantage to the sufferer. After the fever begins to yield, however, it is best to encourage the patient to eat farinaceous foods, such as rice, corn-starch, sago, or tapioca; and, should the pulse show signs of weakness, more nourishing articles of diet, such as animal broths and soups, or beef-essence, must be promptly resorted to. Great care must, however, be used to prevent the invalid from indulging his returning appetite too largely at a time, and so over-distending his stomach to his own serious injury. Not more than half the bulk of one of his ordinary meals ought to be partaken of at once until convalescence is fully established.

*Nursing.*—The nursing in scarlatina is principally to be directed toward avoiding the danger of taking cold, which would be particularly apt to promote the development of the dreaded renal affection. The patient should be kept in bed for a week after the subsidence of the fever, and ought not to be allowed to go out of the house until desquamation is entirely completed,—that is to say, in not less than three weeks, or generally four weeks, from the primary onset of the malady. Since there is no particular susceptibility of the intestines in scarlet fever, ripe fruit in season may be indulged in moderately as soon as the acute symptoms are passed, and, after the headache which usually accompanies high fever subsides, there is no reason for the room of the invalid to be kept darkened, as has been recommended in measles.

Scarlatina is liable to occur in conjunction with small-pox, measles, and perhaps with whooping-cough, and other febrile eruptive disorders. In endeavoring to prevent the spread of scarlet fever, the requisite pre-



cautions have been so minutely detailed in the chapter on Contagion, pages 289–291, that they need not be repeated here. It is, however, necessary to bear in mind that the poison of scarlatina appears to cling with extraordinary persistency to woolen articles of clothing, and cases are recorded of the infection of scarlet fever having been conveyed by handling a throat-flannel at the end of a year, a woolen cap at the end of two years, and a ball of yarn after three years had elapsed.

The use of small doses of belladonna internally, as a prophylactic against scarlatina, when persons are likely to be exposed to the contagion, has been highly praised, but on the whole it is of doubtful efficacy.

### DENGUE OR DANDY FEVER.

This malady, called also three-day fever and break-bone fever, is a contagious febrile disease, attended with rheumatic symptoms and an eruption resembling measles. It occurs in the West Indies and the Southern United States, but is rare in the North. The word dengue is supposed to be a Spanish corruption of the name of the fever, which was, it is said, first applied to it jocosely by the negroes of the island of St. Thomas, where it first appeared, in allusion to the stiff carriage of those affected by it. Persons who catch this curious complaint are often attacked with it very suddenly, frequently in the night after retiring in their usual health. The temperature rises in a few hours to  $103^{\circ}$ , the skin becomes dry and hot, and the countenance indicates utter helplessness and prostration; with this febrile condition, there is usually pain in the head, back, limbs, and small joints, which latter swell up as in rheumatism. The average duration of the first febrile stage is about forty-eight hours, although it may vary from twelve hours to three days, after which the symptoms begin to subside, and a period of remission of two or three days occurs. During this time general debility and muscular pains predominate, and fever is usually absent, but on the fourth day it reappears, and on the fifth or sixth an exanthematous eruption develops, which is sometimes more like the flush of erysipelas than the papules of either measles or scarlet fever. The color, however, is not so intense, and it spreads over the whole body in forty-eight hours. When the eruption reaches its height, painful swellings of the lymphatic glands of the neck, back of the head, armpits, and groins occur. With this tumefaction of the glands, the nose, mouth, and throat become implicated, swelling up and growing excessively painful. On the seventh or eighth day desquamation commences, and the acute stage terminates. The victims of dengue are to be commiserated for the horrible and agonizing pains which they are called upon to suffer, and which are peculiar to the disease; but they may find some comfort in the assurance that the malady is rarely, if ever, fatal. The recurrence of the



excruciating pains in the limbs at a time long after the subsidence of the fever must be borne in mind, as influencing any opinion ventured in regard to the probable duration of the illness.

The diagnosis of dengue must occasionally be made from rheumatism, measles, scarlet fever, and erysipelas; but a complete history of the case can hardly fail to clear up any doubts, particularly if dandy fever is prevailing in the locality as an epidemic.

Since the malady is not a dangerous one, anodynes to relieve the excruciating suffering, especially hypodermic injections of the one-eighth or one-sixth of a grain of morphia, are generally all that is necessary.

### TYPHUS FEVER.

This dangerous and highly contagious malady, also known by the names of camp fever, ship fever, and jail fever, is the result of a specific morbid poison, apparently engendered by crowding together a large number of human beings without due care for proper ventilation and cleanliness. It is a continued fever, attended with a dark-red or purplish mottled rash over the body, with great nervous prostration, restlessness, and delirium, or dullness and stupor, but without any specific affection of the bowels. The eruption, which makes its appearance from the third to the eighth day of the disease, is at first slightly elevated, and disappears when pressed upon with the finger; but after the second day from the time it comes out, it is persistent under pressure, and continues to show this character until it fades ten or twelve days afterwards. The period of incubation of the complaint is about twelve days, and its average duration is about two weeks. When it proves fatal, as it does in about fifteen per cent. of the cases, death usually occurs between the twelfth and twentieth days of the attack. The advent of the disease is somewhat gradual, beginning with general soreness, discomfort, and weariness, with loss of appetite and disturbed sleep. Shivering and a feeling of coldness, especially along the spine, sometimes amounting to an actual chill, not unfrequently mark the commencement, and are soon followed by heat of skin, rise in temperature, and severe frontal headache. This headache is occasionally very severe, and rarely absent at first, but abates about the tenth day. Slumber is disturbed by dreams, is unrefreshing, and when the patient is not asleep there is a constant tendency to heaviness, the mind ceases to think, and the attention cannot be concentrated upon any subject. He may lie with his eyes open, evidently not in slumber, yet indifferent or insensible to all which goes on around him. Bodily weakness is frequently extreme, and the sufferer often voluntarily takes to his bed on the first day of his illness. This exhaustion and prostration is totally disproportionate to the amount of muscular exertion which has been made. The eyes, when examined, are found to be dull and heavy, the white portion injected or

blood-shot, and a peculiar dusky flush overspreads the cheek. As the days pass debility rapidly increases, and delirium comes on the latter part of the first or early in the second week. In persons of nervous, excitable temperament, it commences sooner, and may appear on the third or fourth night of the fever, showing itself primarily, perhaps, by a little confusion of thought on awaking from a restless doze. The tongue is coated at first with a white fur, but after six or eight days often may become dry, swollen, and covered with thick, brownish crusts of mucus and cast-off epithelial cells, which make up what is called *sordes*. The bowels are, as a rule, constipated, and this should especially be borne in mind, because it forms an important distinguishing mark between this disease and typhoid fever, with which typhus was formerly confounded. The pulse is quickened from the outset, and in grave cases continues to increase in rapidity until it may more than double its ordinary frequency, beating from one hundred and forty to one hundred and sixty times per minute. The temperature also rises steadily, generally attaining a height of  $104^{\circ}$ , and sometimes reaching an elevation of  $107^{\circ}$  or  $108^{\circ}$ , which latter degrees of bodily heat rarely fail to indicate a fatal result.

The diagnosis of typhus fever requires to be made in this country chiefly from typhoid fever and relapsing fever, but it is sometimes difficult to distinguish it at first from small-pox, plague, uræmia, glanders, erysipelas, and several other maladies.

As the treatment, diet, and nursing of typhus fever are similar in most respects to what is required in the far more common disease, typhoid fever, the reader is referred to our article upon the latter affection for further information. Since, however, in typhus fever there is no tendency to looseness of the bowels, it is unnecessary to deprive the patient of the refreshing fruits in moderation, which are so generally craved in febrile complaints.

When an epidemic of typhus fever breaks out in a crowded jail, hospital, or tenement, the great cause of its prevalence should, of course, at once be abolished, by separating those exposed to it as widely as possible, and treating the sick in isolated sheds, huts, or even in tents.

### TYPHOID OR ENTERIC FEVER.

Typhoid fever, also called gastro-enteric fever, owing to the circumstance that the stomach and intestines are the chief seats of the disease, is characterized by a faint, scanty eruption of rose-colored spots, appearing chiefly upon the abdomen, from the fourth to the eighth day, and coming out in successive crops. Each crop of spots continues visible for about three days. On account of its frequent connection with bad drainage, this fever has received the vulgar but expressive name of "drain or cess-pool fever," which, despite its indelicacy, it would be well to perpetuate as a constant



warning against that neglect of sanitary arrangements in buildings to which it is chiefly due.

The onset of this dangerous and fearfully prevalent disease is very often a gradual one. The patient for some days feels weak, languid, and depressed, loses his appetite, suffers from headache, and is restless at night. In other cases, however, the malady begins with a slight chill, or a feeling of coldness running up and down the back, and among children the first decided symptom may be an attack of convulsions. Frequently, too, slight bleeding of the nose is noticed, and a little tendency to looseness of the bowels, which may even be aggravated by errors in diet, or other imprudence, into active diarrhœa. These phenomena are called the *prodromes*, or premonitory symptoms, and, although sometimes occurring from a variety of accidental causes, and on the other hand occasionally absent from cases of genuine typhoid fever, are met with in connection with it often enough to possess great importance from a diagnostic point of view.

After the stage of invasion is completed, the pulse and temperature rise steadily, the former going up to a hundred or a hundred and ten, and the latter ascending to  $104^{\circ}$ , or sometimes  $105^{\circ}$  during the first week. The heat of the body is almost always greater at night than in the morning, and this increment is so regularly advanced during the onset of the disease, that it is quite possible for a skilled physician to recognize typhoid fever by a glance at the record of temperature, or "temperature chart," alone in many instances. The diarrhœa rapidly grows more severe, and in bad cases is frequently very profuse, fifteen or twenty thin, watery evacuations occurring in every twenty-four hours. Pain in the abdomen, especially in the region of the right flank, is nearly always complained of, and with the diarrhœa is due to the characteristic ulceration of certain oval spots in the lower portion of the small intestine, which have received the name of Peyer's patches. Bronchial irritation and cough are common. The face sometimes wears an anxious, haggard look, but frequently, even early in the disease, it shows the dull, indifferent aspect, so often indicating an oppression of the brain, which will deepen into stupor, then coma, and finally death. The flush of the face is apt to have a more dusky, purplish tint than in other fevers, and the skin is more dry and burning, or pungent, from the smaller amount of perspiration. During the second week of the attack, delirium generally comes on, and although occasionally violent and requiring the patient to be controlled by physical force, it is more frequently of a low, muttering character. The tongue becomes dry and brown, and tympanites, or the accumulation of gas in the bowels, is generally considerable, and may cause by its enormous distension great suffering, or even lead directly to a fatal result. Ringing or buzzing in the ears with deafness is very often noticed. In bad cases the diarrhœa is often very profuse, and discharges of fluid blood, perhaps in large quantity, sometimes occur and prove quickly fatal. In the third



week, if the case is to end unfavorably, the pulse grows frequent and feeble, the tongue is dry, cracked, and covered with brown sordes, the delirium and stupor are constant, involuntary discharges from the bowels occur, and the patient may die exhausted, or if the fatal issue comes earlier, before complete prostration of muscular strength, it may be preceded by convulsions. If, on the contrary, recovery awaits the patient, the pulse falls off in frequency, the temperature gradually diminishes, the tongue cleans off usually from the edges, appetite slowly returns, and the mental powers are little by little regained. Some of these signs of improvement, marking the turn of the disease, as it is called, may begin to show themselves in mild cases about the end of the second week, generally not until the twenty-first day, and in attacks of great severity not before the fourth or even the fifth week. The unfavorable symptoms, besides those above mentioned, are an unusually high temperature,  $106^{\circ}$  or over, picking at the bedclothes, slipping down in the bed, and entreaties, often of pitiful earnestness, to be taken home.

The diagnosis of typhoid fever must be made in its early stage from typhus fever, relapsing fever, scarlet fever, measles, and small-pox. At a more advanced period it might be confounded with the typhoid condition met with, in uræmia and pyæmia, and also with enteritis or inflammation of the bowels, peritonitis or inflammation of the membrane covering the intestines, meningitis or inflammation of the membranes of the brain, acute bronchitis or pneumonia, and with acute consumption. With the exception of the rose-colored spots, which do not appear in perhaps one-fifth of the cases, there is no characteristic indication of typhoid fever, and the disease must be recognized, if this is done at all, by the combination of symptoms above described. If a patient who has been suffering from headache, prostration, loss of appetite, restlessness, and gradually increasing fever, has a slight bleeding at the nose unprovoked by accident, we may strongly suspect typhoid; but until the rose-colored spots appear, there is no certainty. Many diseases begin with the same symptom, just as many words commence with the same initial, and we must often wait until nature spells out the second or the third letter of her puzzle before we can decide with which one of her cruel problems we have to deal. In a general way, it may be stated that the combination of slight diarrhœa with fever, great prostration of strength, and dullness of intellect, is unusual in any single disease except typhoid: but small-pox, for example, happening to break out in an individual suffering from diarrhœa, might readily lead into error if too much dependence were placed upon this statement. The prudent way is to act in doubtful cases on the safe side, as far as possible, taking the precautions detailed below against aggravating the disease, should it turn out to be typhoid fever, and also those for preventing its spread in the community, should it prove to be small-pox, measles, relapsing fever, or typhus.

*Treatment.*—The medical treatment in typhoid fever, as in other maladies against which we are as yet unprovided with a specific, must be directed towards mitigating suffering, warding off complications, and obviating the tendency to death. In the early stages of the complaint headache is one of the most prominent symptoms, and often calls urgently for relief. Unhappily, as it is an essential part of the disease, being the effect of poisoned blood circulating through the brain, all we can hope for is to procure some mitigation of the intense suffering it frequently occasions. The application of ice to the head, either in a bladder or India-rubber bag, or what is still better by means of an ice-cap, made of numerous coils of thin rubber pipe, through which ice-water is kept flowing, generally diminishes the pain, which, if very intense, may require the application of one or two leeches behind the ears. Diarrhœa, if troublesome, is to be checked, *but not stopped*, by chalk-mixture, bismuth-mixture, or astringents with opium. A good combination is five grains of subnitrate of bismuth, five drops of laudanum, ten drops of compound spirits of lavender, and a tea-spoonful of syrup of Krameria. When the ordinary remedies fail, half a grain of nitrate of silver, three times daily, has proved very efficacious, and it is believed to exercise a directly curative effect upon the ulcerations in the intestines. Its use after the first few days must, however, be continued with great caution, on account of the danger of permanently blackening the patient's skin. Small laudanum injections, or suppositories of one grain of opium and five grains of tannin, or the same quantity of opium and two grains of acetate of lead, are useful when other means prove unavailing. As a diaphoretic and febrifuge, a dessert-spoonful of solution of acetate of ammonia, with or without half a tea-spoonful of sweet spirits of nitre, every two or three hours, is frequently employed with benefit, and, should the vomiting be unchecked by table-spoonful doses of equal parts of lime-water and milk, and by bismuth-mixture, doses of one drop of diluted hydrocyanic or prussic acid may be tried. In cases where restlessness rather than stupor predominates, ten grains of Dover's powder, or a draught composed of twenty drops of laudanum and ten of antimonial wine, will frequently moderate the excitement in a very favorable manner. When the tongue becomes dry, ten drops of the oil of turpentine given in mucilage every four hours, often have a very happy effect, and its influence upon the healing of the intestinal ulcerations is highly lauded. Generally, during the second week, sometimes a few days earlier, and occasionally a few days later, according to the violence of the attack and the patient's strength of constitution, it is advisable to begin with the use of stimulants. The best indication of their becoming needful is a slight failure of the strength of the pulse, but much experience is necessary to judge correctly of the time, the quantity, and the frequency with which alcohol should be administered. At first half an ounce of good whisky



or brandy, with two or three ounces of milk and half an ounce of lime-water, if nausea persists, may be allowed three times daily, but this amount must generally be increased from day to day, sometimes with great rapidity, until in the worst cases a pint and a half of brandy is swallowed in twenty-four hours. Beef-tea, beef-essence, and some farinaceous food, such as arrow-root or corn-starch, ought also to be urged upon the patient at this time. In cases of hemorrhage from the bowels, ten grains of kino, a tea-spoonful of syrup of rhatany, or ergotin hypodermically, in full doses, afford the best chance of success; and if perforation of the intestine, in consequence of the eating through of one of the ulcers, takes place, the very slender hope of recovery is increased a little by the administration of large doses of a grain every hour of opium and by securing perfect rest in bed.

Since many of the worst symptoms of typhoid fever seem to be due to the effect of overheated blood upon the brain, efforts to reduce the temperature by quinine in full doses of from twenty to thirty-five grains, salicylic acid, and especially by the aid of cool baths of about 70° F. six or eight times daily, or cold sponging, have of late years taken a very prominent place in the treatment of the disease, and are believed to reduce markedly its rate of mortality. Where, in spite of judicious employment of means to bring down the temperature, unconsciousness continues, great watchfulness is necessary in regard to the evacuation of the bladder, which may become dangerously distended, and even burst for want of attention. When examined and found to be over-full, the urine should be at once drawn off by means of a catheter, and the operation repeated twice or thrice every twenty-four hours, until the patient resumes control over his functions.

*Diet.*—The diet of a typhoid fever patient must be watched over with unceasing vigilance, as upon it and proper nursing, more than upon medical treatment, the chances of success often depend. In the first stages it should be light, entirely unstimulating, and unrelaxing to the bowels. Throughout the whole course of the disease no solid food ought to be allowed, and this precaution should be rigidly enforced on account of thereby avoiding the risk of mechanically rupturing some little hole in the intestine, at the seat of an ulcer which had almost perforated the wall of the bowel. Such a catastrophe must, as already hinted, lead to almost certain death. As the thirst is usually very great, whilst the appetite is nearly lost, it is a good plan to make the drinks somewhat nourishing, in order to support the strength. Hence, gum-arabic water, barley-water, or milk thickened with tapioca, sago, or corn-starch, are often highly advantageous. If the usual tendency to diarrhœa is at all marked, fruits of all kinds ought to be entirely withheld by the nurse, and even where the bowels are not disordered, fruits and vegetables, other than those enumerated, should be very cautiously given, on account of the disposition to



looseness of the bowels which generally exists. Many cases of death from typhoid fever may be directly traced to the murderous imprudence of nurses and attendants in this respect. During the second week, when slight indications of debility usually begin to manifest themselves, a more nutritious diet becomes necessary. Thicker preparations of the farinaceous foods above mentioned should be employed, beef-tea and beef-essence may be added to the list, and as debility increases eggs beaten up with milk, flavored perhaps with a little wine, if they have been well borne during health, may be administered. In the latter stages, when the whole capacity of the enfeebled digestive organs is needed to take up sufficient food to sustain life, strong meat-soup, beef-essence, eggs beaten up with wine, and milk punch should alone be urged upon the patient. Life has apparently been saved in some instances by frequently repeated small injections of beef-essence, brandy, and milk, with a few drops of laudanum, in order to prevent the enema from being rejected from the bowels, as is too often the case in spite of all our efforts.

*Nursing.*—In nursing a case of typhoid fever, the patient, watchful, and judicious care of a skillful attendant often contributes in those instances having a favorable termination, as most candid physicians will admit, more than medical treatment to the sick man's recovery. The suitable administration of medicines to control diarrhœa, according to the varying phases of that important symptom; to relieve restlessness and allay excitement; the proper employment of baths to reduce febrile heat and diminish cerebral congestion; the constant guarding of the patient from injurious articles of food; the increasing effort to economize the failing strength, which otherwise may prove just a little lacking in the last great day of struggle with the disease, notwithstanding all the reinforcements called upon in the way of stimulants and nutrients to support it, all these offer an ample field for the highest intelligence and the noblest self-sacrifice. And it is doubtful whether any more gratifying earthly reward can be won than the satisfaction of triumphing over death, and nursing back to the joys of life some dear relative, beloved friend, or useful member of society, whose warmest gratitude for the service, even if not paid, will always be due.

Besides the general attentions pointed out in the chapter on Nursing, and the special care already sufficiently indicated in this article, the attendant upon a typhoid fever case must be on his guard, lest in his momentary absence the delirious patient get out of bed and attempt to escape from the house, or perhaps throw himself out of a window. Even the effort at walking across the room may, in the weak conditions met with in the latter portion of the fever, so exhaust the failing strength as to lead to dangerous or fatal collapse. The tendency to bed-sores, which are particularly apt to form over the portions of the body pressed upon in lying upon the back during typhoid and typhus fevers, must be overcome, as

far as possible, by frequent change of position, the use of perforated pillows or cushions, and of water-beds. As a general rule, the formation of a bed-sore in a case of typhoid fever not lasting more than twenty-five to thirty days, is evidence of carelessness on the part of the nurse, and should never be permitted to occur. When once developed, bed-sores must be kept clean and carefully dressed once or twice daily, in the hope of preventing them from spreading, as the chance of curing them until the patient can sit up is exceedingly small. Not only is the suffering from bed-sores very great, but the free discharge of pus which they generally yield is extremely debilitating, and quickly exhausts the little remaining stock of strength.

The mortality of typhoid fever varies in different epidemics from ten to twenty per cent. The older the patient, the less is his chance of recovery from the malady, whilst among children the proportion of deaths is quite small. Prof. Wood reports a series of eighty-six cases in the Pennsylvania Hospital with but five deaths, or only one death in each seventeen cases; but such success in treatment is certainly exceptional, and may be attributed to extraordinary skill and care. He declares that a case should never be looked upon as absolutely desperate, as there is no condition so low, no symptom so fatal, that death should be considered inevitable. On the other hand, some of the mildest cases, those to which the name of "walking typhoid" has been appropriately applied, may suddenly terminate in perforation of the bowel, and death in a few hours from collapse or from peritonitis. On this account a typhoid fever patient, no matter how slight his symptoms of illness may be, should stay in bed, and swallow nothing but liquid food, until the searching test of the thermometer shows that all febrile movement has subsided.

Even after convalescence has fairly set in, great watchfulness is necessary. Permission to sit up in bed even ought not to be given until several days have passed without any fever, as proved by the thermometer, which should be used morning and evening throughout the complaint, and the return to solid food must be both slow and gradual. Any imprudence in diet, or slight over-exertion, may bring on a relapse, which is much worse than the original attack, and its causes ought therefore to be most sedulously shunned. The present writer has seen death result from such a renewal of the disease in a hospital patient, brought on by some pie smuggled into him, in spite of express cautions against indulging his appetite, which had begun to improve; and Dr. Wood records a case of death under similar circumstances from a free use of peaches. It is probable that for a long time the ulcerated patches in the intestines remain tender and irritable, if not actually inflamed, and therefore that several weeks, or even months, should elapse before the convalescent patient fully resumes his usual habits of life.

The great means of preventing typhoid fever by unceasing vigilance



in regard to the purity of the water-, milk-, and air-supply, has already been so urgently insisted on, that a mere reference to pages 66, 191, and 125, is sufficient here.

### CEREBRO-SPINAL OR TETANOID FEVER.

This is a malignant epidemic fever, usually attended with painful contraction of the muscles of the neck and retraction of the head, and frequently accompanied by a profuse purpuric eruption. It is a disease which generally comes on suddenly, runs its course with great rapidity, and proves fatal in a majority of instances. The malady is more than a mere inflammation of the membranes of the brain, or meningitis, for the whole nervous system seems to be very gravely affected from the first. Premonitory symptoms are rare, but when they are met with, show themselves simply as slight headache and pain in the back, or a little uneasiness and weariness experienced for several days before acute symptoms set in. These may commence with a chill or marked shivering-fit, followed by intense vertigo, headache of intolerable severity, obstinate and violent vomiting, painful muscular stiffness, soon developing into continuous spasms, similar to those in lockjaw or tetanus, and affecting particularly the muscles of the head and back. Distress in the head is constant so long as consciousness lasts. The eyes are blood-shot, and express agonizing suffering, the pupils are contracted, and the countenance is pale. Excessive restlessness and general muscular agitation prevail, and the sensibility of the whole surface is so great that every touch and movement causes excruciating pain, and even touching the hair is painful. These symptoms increase up to the third or fourth day, when the power of swallowing begins to be affected, and the process of respiration to be imperfectly and irregularly performed, the head being dragged tightly back as far as possible, and the features fixed in the horrible and characteristic grin of lockjaw. The delirium usually developed during the third day, if it has not sooner appeared, passes into stupor, and this in its turn deepens into coma, from which or from suffocation death commonly releases the sufferer between the fifth and eighth day of the complaint, or in a few cases the patient may gradually improve, and after three or four weeks enter upon a tedious convalescence of many months' duration. The fever is generally remittent, and though the most elevated temperatures prevail in the most rapidly fatal cases, the thermometer does not rise as high as in either typhus or typhoid fever.

The diagnosis between this disease—which, it should be stated, has also been named epidemic cerebro-spinal meningitis, or purpuric fever—and typhus fever, typhoid fever, tetanus or lockjaw, meningitis, and typhoid pneumonia, is usually not difficult, except in the earliest stages. The fact of its epidemic prevalence generally aids at once to its recognition,



except in the first few cases which occur, and even in these the intolerable headache, retraction of the head, and excessive sensitiveness of even the hair to the lightest touch, are almost always sufficient to characterize this strange and terrible malady. It is most apt to appear as an epidemic in the winter and spring months, affects children more frequently than it does adults, although the latter are likewise susceptible, and one attack does not seem to afford any subsequent immunity. The death-rate varies from thirty to seventy per cent.

*Treatment.*—The treatment consists of dry or cut cups to the nape of the neck and along the spine, cold to the head by means of ice-bags or bladders, or better still the ice-cap, opium in quantities of a grain every two or three hours, and especially hypodermic injections of morphia, to relieve the agonizing suffering as well as for the direct curative effect which opiates seem to possess in some instances, and iodide of potassium and ergotin, in full doses of five grains respectively, every four hours.

Although it is by no means certain that unhygienic conditions can produce the poison of this complaint, there is no doubt that emanations from sewers, deficient ventilation, and the overcrowding together of human beings, promote its development. Hence, in attempting to combat the causes of an epidemic of cerebro-spinal fever, particular attention should be paid to these disturbers of health, as pointed out so fully in the chapter on Epidemic Influence.

### RELAPSING OR FAMINE FEVER.

This malady breaks out in badly-fed, overcrowded communities, and in some respects resembles typhus fever, though it differs in the absence of eruption. Its onset is usually abrupt, without any preliminary symptoms, and the febrile attacks, usually severe though of short duration, pass away leaving the patient comparatively well for a few days. After an interval of about a week, however, a repetition of the primary attack is experienced, and this relapse, from which the disease takes its name, may recur four or even five times. Relapsing fever is remarkable for being the first human febrile affection of a paroxysmal character which has been definitely connected with the development of a vegetable organism in the blood. It therefore forms a most important argument in favor of the germ-theory of disease. The peculiar vegetable organisms belonging to the *Spirochetes* are found in the blood of relapsing fever patients by tens of thousands, and disappear during the temporary convalescence, to reappear with the recurrence of the febrile attack. The onset of the malady is marked by a chill or shivering-fit, severe headache, vomiting, and often jaundice; a white, moist tongue, tenderness over the pit of the stomach, constipation, enlarged liver and spleen, high-colored urine, a frequent, full, and often bounding pulse, pains in the back and limbs,

and frequently delirium. These symptoms abruptly terminate between the fifth and eighth day, as a general rule, by an exceedingly copious perspiration, and, after an interval of a week, during which it may be supposed that a new crop of the bacteria are ripening, and in which time the patient is often well enough to get up and walk about, a sudden relapse takes place, running through the same phases as the original outbreak, except, perhaps, that it is a little shorter. This alternation of apparent recovery and relapse in successive weeks may be repeated four or even five times before the patient gets rid of his disease. When death occurs, it is apt to happen from a fainting-fit, following excessive perspiration, or from coma, the result of suppression of the renal secretion, but as seen in America the fatality is very small, being on an average less than two per cent. This disease is a very exhausting one, and the patients may remain sickly for months, exhibiting all the signs of profound impoverishment of the blood, such as extreme debility, pallid countenance, dropsical swelling about the ankles, palpitation of the heart, noises in the ears, dimness of vision, diarrhoea, and dysentery. As observed abroad, where it appears to have been a much graver affection than it has hitherto shown itself in this country, fatal and troublesome complications were apt to be induced in this complaint, such for example as bronchitis, pneumonia, abscess of the spleen and kidney, and a peculiar form of blindness from loss of power in the optic nerves.

The diagnosis of relapsing fever cannot be positively made by the general symptoms during the primary onset, but may be strongly suspected, and the relapse looked for if the disease is prevailing, and exposure to the contagion has occurred. A microscopical examination of the blood during the height of the febrile movement will, however, determine the presence of the spiro-bacteria, and this investigation ought therefore always to be made, not only in cases which are supposed to be relapsing fever, in order to confirm the diagnosis, but also in instances of supposed typhoid, typhus, and other eruptive maladies, which might really be examples of this remarkable affection.

*Treatment.*—Although so far advanced in our knowledge in regard to the vegetable nature of the true contagion of relapsing fever, we have not yet made equal progress in the specific treatment of this complaint, although much may be hoped for from the judicious administration of the sulphite of soda in twenty-grain doses thrice daily, and perhaps of corrosive sublimate and arsenic. The great problem, of course, is to find some mineral substance which can be taken up in the blood in sufficient quantities to check or prevent the growth of the bacteria in that vital fluid, without seriously injuring the patient himself. Quinine, so useful in intermittent fever, has proved almost worthless in this disease, and our chief reliance to reduce the high temperature is at present on cool baths or cold sponging. If the headache is very severe, dry cups to the back

of the neck and along the spine may be employed, or one or two leeches may be applied behind the ears, although, since the tendency of the disease is towards great debility, it is better to avoid the abstraction of blood if possible. Opium or morphia by the stomach, or still better by hypodermic injection, is often necessary to relieve the headache and the severe pain in the limbs, and if symptoms of prostration come on early, wine or brandy must be resorted to, as already recommended in typhoid fever. A very careful watch must be maintained over the functions of the kidneys, since one of the great dangers of the disease appears to be the failure of these organs to perform their duty of purifying the blood from urea, which, when allowed by renal negligence to accumulate in the system, frequently causes death by uræmic poisoning. The urine should, therefore, be frequently examined, its total daily quantity noted, and the existence of albumen tested for. Should evidences of deficient excretion be found, the case should be promptly treated as recommended under the head of Uræmia. On account of its favorable action on the kidneys, sweet spirits of nitre in quantities of a tea-spoonful every four hours, or as combined in the febrifuge recommended in the article upon Small-pox, is particularly applicable. In order to save the strength as much as possible, the patient ought to keep in bed during the week of remission before the relapse; and throughout the tedious convalescence, which so frequently follows, the powerful tonics, such as quinine, strychnia, iron, and cod-liver oil, aided if convenient by a visit to the seaside, or other change of climatic conditions, afford the best prospect of speedy success.

### SIMPLE CONTINUED FEVER AND FEBRICULA.

The two groups of cases thus denominated comprise examples of fever without eruption, inflammation, or other sign of their being due to any specific cause. The former is made up of all those cases which exceed in duration the arbitrary limit of four days, and the latter all those slight feverish attacks which run their course in less than this period. It is highly probable that most of the instances in both groups are mild attacks of some of the febrile affections already described, which, in consequence of some unknown peculiarity, or feebleness of the fever poison, or of the constitution of the patient, never develop their characteristic symptoms, and therefore remain unrecognized and, indeed, utterly unrecognizable. We have some reason to suppose that this may be the case, in the fact, amongst many similar ones, that certain susceptible adults, whenever they are exposed to the poison of scarlet fever, suffer quite severely from sore throat without manifesting other and graver symptoms of scarlatina. Acting on this hypothesis in default of a better one, the nursing and care of simple continued fever, and of febricula, are very important, since due care may at any time prevent the full development of one of the dan-



gerous or fatal affections, which have been hitherto under consideration in this section.

The symptoms are, as will be readily understood from this explanation, slight chill or chilly feelings for the initial disturbance, followed in a few hours by headache, quickened pulse, rise in temperature, and constipation. Very often in persons of sensitive stomachs there is a little nausea or vomiting for twelve or twenty-four hours, and again with those of sensitive skins there may be a slight eruption of roseola, or prickly-heat, as it is often called, especially about the loins and over the back. The fever may run high enough for the overheated blood to disturb the brain and produce some delirium, especially at night; but at the end of a period, varying in duration from twelve hours to ten days, the febrile symptoms usually subside without any further derangement of the system than a very copious and debilitating perspiration, or perhaps an outbreak of the vesicles of herpes, commonly denominated "cold sores," about the face or elsewhere. Such attacks as these cause much needless anxiety, needless at least in the Northern States, to both physicians and patients, the former dreading the onset of typhoid fever or other dangerous disease, and the latter suffering an agony of suspense from which, for a time, all the knowledge of Hippocrates or Æsculapius himself could not deliver them.

*Treatment.*—The patient in these puzzling cases should be kept in bed, and allowed only light unstimulating liquid food. Cold applications may be made to the forehead and temples to relieve headache, and diaphoretics combined with anodynes, such as nitre and morphia, as already directed, to reduce fever and allay restlessness. Lumps of ice are useful and refreshing to the throat when swallowed, and whilst there is constipation, ripe, sweet oranges in moderation are generally safe. It is probable that various nostrums win many of their greatest triumphs in the so-called "cures" of febricula, and simple continued fever, which are trumpeted abroad as victories over typhoid and typhus.

## YELLOW FEVER.

This is a pestilential fever, usually of a continued but sometimes of a paroxysmal type, characterized by yellowness of the skin, and accompanied in the severer cases by black vomit, suppression of the urine, with hemorrhage from the stomach, nose, and mouth. It is almost peculiar to tropical climates, and not apt to spread in temperatures below 72° Fahrenheit; it is extremely fatal, perhaps communicable from person to person, and in the United States has occasionally proved itself violently epidemic.

Yellow fever presents two well-defined stages. The first is characterized by intense pain in the head and back, injected eyes, rapid pulse, and elevated temperature. This stage may last from twenty-four hours to six

days, according to the severity of the attack. The second stage is marked by depression of the nervous and muscular forces, and of the general and capillary circulations, slow and intermittent pulse, jaundice, urinary suppression, passive hemorrhages from the bowels, nose, gums, uterus, and nearly all the organs lined with mucous membranes, and, in cases of unusual severity, also from the eyes, ears, and skin. Black vomit, delirium, and coma generally terminate in death.

In mild cases of yellow fever, it will often be difficult to discriminate the complaint from febricula, except by the circumstance that the more dangerous disease is epidemic. Such attacks, observed at the commencement of an outbreak, are generally reported as malarial fever, in order to avoid the excitement and disturbance to mercantile interests which would be apt to arise if a panic were originated; and, indeed, many instances seem so trivial that an honest difference of opinion may well be entertained as to their serious import. In more severe cases the symptoms resemble to a considerable extent those of relapsing fever, and it is impossible to foretell from any of these indications how serious these consequences may prove to be. In truth, these sequels constitute the most distinctive characteristics of yellow fever, and comprise the "black vomit," so well known and dreaded as a fatal symptom. They generally make their appearance within forty-eight hours, sometimes after the fever has apparently in part or completely passed away, on other occasions before the high temperature is reduced. The black vomit is frequently preceded by the white vomit, as it is called, which is a clear acid liquid, and at this time some pain is usually felt on pressure over the pit of the stomach. The occurrence of this black vomit is well known, even among sailors to West Indian ports, as a fatal sign in yellow fever, although occasionally a patient recovers after this gloomy harbinger of death has manifested itself. Profuse bleeding from any of the various situations referred to is also an occurrence of serious significance. The yellow-jaundiced hue of the skin, when well marked, indicates a severe form of the disease, but has by no means the terribly fatal import of the black vomit. Where death in yellow fever is not directly due to the debilitating effect of loss of blood, it can generally be traced to uræmic poisoning, as a result of suppression of the urine. The present writer, some years since, had an opportunity of examining the kidneys of some yellow fever patients, and demonstrated the presence of a most abundant growth of bacteria in them, mechanically preventing them from performing their duty in the excretion of the urine. He therefore believes that death is, at any rate sometimes, due in fatal cases to this development of a low form of vegetable organism. Such a view of the fungoid nature of the yellow fever contagion is very much strengthened by the circumstance that it has been found so repeatedly to break out in the neighborhood of a vessel recently arrived from a port at which yellow fever was raging. And yet this



event can apparently only occur when the requisite favorable conditions are found at the new starting-point. These conditions have over and over again been proved to be continued heat above 70°, moisture, and vegetable decomposition. As might be anticipated, the discharges from the bowels and the black vomit appear to be the chief agents in propagating this malady, and therefore the greatest watchfulness is imperative in the disinfection and subsequent safe disposal of all the substances evacuated from the stomach and intestines. The material cause of the complaint contained in them, no doubt composed of the spores of bacteria, as above pointed out, is remarkable for its localization in ordinary seasons in small areas of country, often less than a mile square, and in the United States chiefly confined to the coast of the Gulf of Mexico and of the Atlantic Ocean south of Philadelphia, save in particularly unfavorable seasons, when we may have epidemics even in this city and in New York. Such portability of the cause of yellow fever is a very curious feature in the history of the disease, and a very important one from a sanitary point of view, because upon it hinges the whole value of quarantine in regard to this malady. The many well authenticated instances, says our great American sanitarian, Dr. Billings, which we have recorded of the introduction of yellow fever into a place by means of infected bedding or clothing, and its steady spread thereafter, in some cases keeping on one side of the street and passing from house to house with the regularity of a postman, at the rate of about forty feet a day, are exceedingly difficult to explain, unless we assume that this poison is not only material and solid, but also living, so that it can increase outside of the body. The old farmer's remark, that "Yellow Jack can't go anywhere unless you tote him," is quite true for distances of a few miles, but for a few squares only he seems to be able to get along without human assistance.

In regard to this important subject it may be stated that, among the most practical results of the great Yellow Fever Conference of the Public Health Association at Richmond, Virginia, in 1878, were that the Commission appointed to investigate the pestilence of that year, which spread such fearful devastation in the Mississippi Valley, found, first, no single instance of a case of yellow fever which they could consider indigenous to its locality in the United States; second, that in respect to most of the towns which they visited, and which were points of epidemic prevalence, the testimony showing importation was direct and convincing in its character; third, the transmission of yellow fever between points separated by any considerable distances, appeared to be wholly due to human intercourse. In some instances the poison was carried in the clothing, or about the persons of people going from infected districts; in other instances it was conveyed in such *fomites* as goods of some description, or bedding and blankets.

A second and most important question was in regard to the efficacy of



isolation and local quarantine, and upon this point the commission reported that quarantines established with such a degree of surveillance and rigor that absolute non-intercourse was the result, effectually and without exception protected those quarantined from attacks of yellow fever. In many Southern towns "shot-gun quarantines" were established, by the citizens organizing into vigilance committees, and appointing well-armed guards to watch night and day, and drive back or shoot down all refugees from infected districts. The united testimony of eye-witnesses was, that wherever this murderous safeguard was rigorously and mercilessly enforced, it was completely successful.

A very distinguished member of this commission, Prof. Bemiss, of New Orleans, declared the following year, after still further investigation, that the specific nature of the poison of yellow fever is shown by the inconvertibility of yellow fever into any other disease; further by the certain recognition of the disease through clinical histories, found in the earliest records and down to the present time; and also by the fact that it is portable from one place to another, and produces identically the same disease in places to which it has been carried. He further asserts that this poison is reproduced chiefly, if not wholly, within the human body, but undergoes some change after its escape from the body, which increases its poisonous properties. It possesses ponderability and some certain unknown quality, which causes it to adhere to solid surfaces. On account of these characteristics of the germ, the disease is seldom communicated from the persons of the sick, but is generally contracted by visiting infected localities, or by contact with infected things. Finally, he maintains that, as the disease cannot be cured by any antidotal or eliminative treatment, our remedies are limited to those medicines which are useful in controlling symptoms, also that the only safe prophylaxis is to keep unprotected persons out of the range of infection, either of localities or things, by a rational system of quarantine, a careful isolation of the sick, and cleansing and disinfecting all contaminated localities and *fomites*.

*Treatment.*—The treatment of yellow fever, therefore, is unhappily confined to the administration of lime-water and milk, or of ice in small pieces, to relieve vomiting and check hemorrhage into the stomach; hypodermic injections of ergotin, in three-grain doses, to control the tendency to bleeding from the mucous surfaces generally; morphia, also hypodermically in half-grain doses, to palliate the suffering; and, when the pulse begins to fail, alcohol either in the form of iced champagne by the stomach, or injected with beef-essence and milk into the bowel.

In the tedious convalescence which is apt to follow if the patient does recover, the profound anæmia, which is one of the prominent symptoms, should be combatted, as already recommended in similar cases, with iron, quinine, strychnia, cod-liver oil, extract of malt, and the most nutritious food which can be borne.

*Nursing.*—As respects the nursing in yellow fever, the most important thing to be attended to is that of securing absolute quiet, both of mind and body, for the sufferer, and the administration of warm-air baths to promote the action of the skin, when the renal secretion is diminished or suppressed and there is danger of blood-poisoning from the accumulation of urea in the circulating fluid. The care of the diet is almost a sinecure, since there is generally no appetite for food, and the danger of provoking black vomit renders it advisable to introduce nothing into the stomach, whether as food or medicine, which can possibly be avoided.

### PLAGUE.

This disease, which is identical with the pestilence of India and the black death of Europe in former ages, is defined as a specific fever, attended with buboes or boils of the lymphatic glands of the groins, as well as other glands, and occasionally with carbuncles. It is very easily communicated by human intercourse, and is probably the most fatal of all the eruptive fevers. Although the inhabitants of the United States have hitherto been spared any visitation from the plague, yet, as the shipments of rags from Italian ports with marble, for which they are used as wrapping, is carried on quite extensively, germs of this terrible malady may at any time be imported and planted within our borders. In the last great outbreak of plague in Astrakhan, a province of south-eastern Russia, the starting-point of the whole epidemic was, it is said, traced to a shawl, brought by a Cossack returning from the war in Afghanistan, as part of his booty, and presented to his sweetheart. The girl wore the fatal gift for a few days, when she sickened with all the symptoms of plague and died. During the following four days the rest of her family, six in number, sickened and died. From these poor people the disease spread rapidly, and proved very fatal, devastating nineteen villages in that district. Its deadly march was only checked by a double cordon of soldiers being placed around the infected towns, and absolute non-intercourse, on the plan of the shot-gun quarantines of our Southern States, enforced.

Dr. Döppner, the only survivor of eight medical officers ordered to the assistance of the afflicted inhabitants of these districts, says that, in the milder cases, patients were attacked with violent headache, transient shiverings, alternating with intense heat of skin, sometimes terminating in death from prostration. In the more severe form the persons affected were suddenly seized with palpitation of the heart, irregularity of the pulse, vomiting, difficulty of breathing, spitting of blood, and syncope or fainting. The face became pale, the expression apathetic, the eyes dull, and the pupils dilated. The patients lay for three or four hours in a state of absolute prostration, and then a violent accession of fever with delirium followed, in which the urine was suppressed, and the bowels con-



stipated. Dark purplish spots, from one-tenth of an inch to one inch in diameter, appeared over the body, which exhaled a peculiar odor somewhat resembling honey, and death was preceded by lethargy and collapse. The corpses became putrid in two or three hours after decease. Death sometimes occurred in twelve hours from the first onset. In the village of Vetlianka, out of eighteen hundred inhabitants, six hundred, comprising nearly all who did not take flight in the panic originated by the first group of fatal cases, died of the plague.

The period of incubation is variable, but may be as short as two days, and the duration of the fever about a week, if the patient's strength be not sooner exhausted. The abscesses in the lymphatic glands do not usually ripen until after the fever declines, or about the eighth or ninth day of the attack. Some high authorities consider the plague is only a very violent and epidemic form of typhus fever. The treatment and hygienic care are similar to those of this latter complaint.

### AGUE OR INTERMITTENT FEVER.

This is a disease attended by paroxysms or fits of severe chill followed by fever, succeeded by intermissions of the febrile condition, during which the sufferer, though he may be enfeebled, is comparatively well. The paroxysms are characterized by three periods, the first or cold stage being that in which the shiverings occur. Next comes the hot stage, in which all the symptoms of fever are manifested, comprising headache, nausea or vomiting, heat of skin, which may attain an elevation of  $105^{\circ}$ , full, strong, rapid pulse, and occasionally delirium. After this follows the sweating stage, during which profuse perspiration takes place, and the temperature is reduced, as a consequence, nearly or quite to the natural standard. The paroxysms, thus constituted, generally recur with considerable regularity, but may vary a good deal in different cases in regard to the interval between them. The varieties of ague designated in accordance with this difference are, first, the quotidian or daily ague, in which the fit comes on usually at the same hour every day; second, the tertian ague, the most common form, when the paroxysm returns every forty-eight hours whilst the disease continues; third, the quartan, where the fit occurs every seventy-two hours, or on every fourth day; and fourth, the irregular ague, in which the fits are not distinctly periodical. Under this head is included the kind of periodical neuralgia affecting the forehead, and hence denominated brow-ague. In the quotidian form, the paroxysm is apt to be the most prolonged, and may last for sixteen hours out of the twenty-four, leaving of course only eight hours between its termination and the commencement of a new chill; in the tertian form, the fit is less protracted, lasting on an average about ten hours; and in the quartan it is still shorter, having an average duration of only six



hours. In a fit of tertian ague continuing ten hours, we may expect to find the chill lasting from half an hour to an hour, the febrile stage, during which the patient often declares he feels as though he were burning up, extending over from three to five hours, and the sweating stage occupying the remainder of the time.

Another variety of disturbance produced by the malarial poison has been designated as masked intermittent fever. In this form various functional derangements, especially neuralgia in different portions of the body, as for example the brow-ague, already alluded to, have a paroxysmal type. Generally the thermometer will show a slight rise of temperature during the period of greatest intensity in the pain, and the accuracy of the diagnosis may be proved by the prompt cure which results from a judicious administration of quinine.

Still another form is the latent intermittent or "dumb-ague" of common parlance. In this variety a close observation will generally enable the patient to discover some periodicity in his symptoms, and the test, as in the preceding variety, is the curability by quinine or Peruvian bark.

The most common secondary affection which occurs in the course of intermittent fever, and appears to be directly dependent upon it, is the chronic enlargement of the spleen, called "ague-cake." During the cold stage of the fit, it is probable that the spleen is always more or less distended with blood, which, being driven from the surface of the body whilst the chill lasts, finds its way to the internal organs, and especially the spleen, in unusual quantity. Such congestion, if frequently repeated, seems to lead, in a majority of cases, to a real increase in amount of the structure of the spleen, and consequent enlargement of the organ. The "ague-cake," when fully developed, may attain a magnitude of a foot or more in length by ten inches in breadth, and even when much smaller than this, may be felt as a hard, painful, and movable tumor, on the left side of the abdomen, a few inches below the heart. Such increase in size of the spleen generally indicates a rather profound impression of the malarial poison upon the system, and renders the prospect of speedy cure far less hopeful.

Another serious complication of prolonged ague is the intense anæmia, which so many persons who suffer from malarial poisoning often exhibit to a marked degree. The absence of the natural supply of good, rich, red blood gives to the skin, and especially that of the face, a dull, yellowish tint, which in malarious regions is displayed by most of the inhabitants, even the children exhibiting a pallid sallowness pitiful to behold. There is also a peculiar dejected, woe-begone expression of countenance, which is almost characteristic of malarial poisoning, and feelings of muscular weakness and fatigue on the slightest exertion are very common.

The diagnosis of ague is seldom difficult after the first paroxysm, as

the regular recurrence at the same hour of the day is a feature which is so characteristic that it has given the name of "periodical fevers" to the febrile affections caused by malaria. At the first onset, it is impossible to distinguish the chill from the initial symptom of a great number of diseases, but a knowledge of the fact of the patient's being exposed to malaria will often serve to allay anxiety, lest it should prove to be the commencement of some dangerous disease.

*Treatment.*—In the medical treatment of all the periodical fevers, we fortunately possess a specific of wonderful power in quinine and the other alkaloids of Peruvian bark, which have a direct control over the malarial poison, probably by checking the development of the *Bacillus malarix*, which has been already referred to as being the presumptive cause of ague. It formerly was the custom to prepare the system, as it was called, for the administration of quinine, by the purgative action of full doses of blue-pill or other active cathartic. At present, however, the custom among many physicians is to proceed at once to destroy the cause by giving quinine in sufficient doses, during the sweating stage, to produce the slight deafness and ringing in the ears which mark the occurrence of cinchonism, as it is denominated. As a general rule, it is quite possible to do this before the time for another paroxysm, even with an attack of intermittent fever of the quotidian type. The antiperiodic must, however, in order to effect a cure, be continued in full doses of from ten to thirty grains daily, for three or four days, then reduced to half or one-third this quantity for a few days, and so persevered in for three weeks. For the purpose of counteracting the tendency which intermittent fever possesses of recurring in its original violence at intervals of exactly one week, it is advisable to take the full dose of from ten to thirty grains, or whatever amount has been found to produce slight buzzing in the ears, on the sixth and seventh, the thirteenth and fourteenth, and the twentieth and twenty-first days from that on which the last chill was experienced. In this way not only the periodicity of single ague-fits, but also the periodicity of groups of the intermittent fever paroxysms, appears to be most effectually extinguished.

Unfortunately there are some few people who cannot tolerate enough quinine to produce its antiperiodic effect, and there are a few others upon whom it seems to have no influence towards controlling the ague-fits. For such persons avoidance of malarious regions is of tenfold importance, since the substitutes for this potent drug are very inferior to it in their power over the disease. In case quinine fails or is not tolerated, other alkaloids of Peruvian bark, and preparations of the bark itself, should be fairly tried. A famous East Indian mixture for the cure of ague is Wartburg's tincture, and it may be resorted to when ill-success with other forms has been met with. The alkaloids of Peruvian bark are, as a rule, much more efficacious in solution with some mineral acid, such as the

dilute sulphuric acid, and it is probable that many of the reported failures of quinine to cure fever and ague are due to the fact that pills which had become so hardened by age as to remain entirely undissolved during their passage through the alimentary canal, were used; or the same ill-success may have resulted from the coating in which they were ensheathed, for the purpose of disguising the bitter taste, being similarly firm enough to resist the solvent action of the digestive fluids.

Where for any reason Peruvian bark and its preparations fail to cure ague, the best substitute, although a far inferior one, is probably arsenic, particularly in the form of Fowler's solution, administered in quantities of five drops thrice daily, and formerly well known under the name of the tasteless ague-drop. Salicylic acid and the salicylates, also the sulphite of soda and other alkalies, have been recommended for the treatment of ague, and reported to have met with gratifying success. Still the superiority of quinine as an antiperiodic continues to be an admitted fact, and its importance to inhabitants of malarious regions, as well as its commercial value, have so stimulated the inventive genius of organic chemists in this country and in Europe, that we may at any time be called upon to rejoice in the discovery of a practical method by which quinine or its equivalent can be artificially and cheaply produced.

*Diet.*—No particular care of the diet is requisite in intermittent fever, except to counteract as far as possible the tendency to anæmia and general debility, by a liberal supply of the most nutritious food which the digestive powers are able to assimilate. In like manner, as the patient is not confined to bed, directions about nursing are unnecessary.

The remedy to be used in preventing an attack of malarial poisoning, when temporary residence in a fever and ague district is unavoidable, is quinine used internally, as already suggested, in doses of six or eight grains daily. Many people have a dread of the continued use of quinine in this way, alleging that it is apt to stay in the bones, and that they have known persons to suffer for years from pains like rheumatism in consequence of its employment. The fact is, however, that such pains are often due to the evil effect of the malarial influence, which this unfounded fear of Peruvian bark and its alkaloids has prevented the sufferer from getting rid of soon enough, to avoid the deeper-seated derangements of health due to malaria from becoming manifest. Dr. Flint declares that he has repeatedly known of instances where ten grains of the sulphate of quinine, the usual form, were taken daily for several consecutive months, without inconvenience or unpleasant results.

#### REMITTENT OR BILIOUS REMITTENT FEVER.

This disease is also believed to be produced by malaria, modified in its action by some peculiarity in its mode of production, or in the constitution of the patient. It takes the form of a fever, having somewhat irreg-



ular exaltations and remissions, without, at any time, entirely passing off, as is the case with intermittent fever. There is generally intense headache, the pain darting across the forehead, and producing a sensation of tension within the brain, as if the skull would burst open. It is accompanied with more or less functional disturbance of the liver, and consequently, as a rule, with a mild form of jaundice, exhibiting itself as a sallowness or marked yellowness of the skin, and particularly of the whites of the eyes. This yellowness is believed to be directly due to the reabsorption of the elements of bile into the blood, and consequent yellow coloration of the serum of the circulating fluid.

The fever in this form of disease presents itself with almost all grades of intensity, from that of almost complete remission, resembling a severe variety of ague, to the continuous burning heat, approximating very closely to the deadly malarious yellow fever.

At the commencement of an attack the usual chilliness, restlessness, lassitude, and depression usher in a moderately well-defined cold stage, which is quickly followed by the hot stage, as described under the head of Ague. Sometimes the attack is very sudden, and comes on almost without any preliminary cold fit, a hot stage setting in abruptly with much greater intensity than that which accompanies the ordinary forms of intermittent fever. The hot stage or exacerbation is generally developed about noon, or early in the afternoon, and may continue throughout the night, subsiding towards morning, when, as a rule, the fever remits, that is to say, diminishes, without entirely passing off, and comparative comfort is enjoyed for eight or ten hours. Each paroxysm, including of course this remission, may last, as thus described, for twenty-four hours, or its duration may be thirty or thirty-six hours, in which case the time of the remission will fall in a different portion of the day, on successive occasions of its recurrence. These paroxysms have a tendency to last seven, fourteen, or twenty-one days, and may end suddenly by a sweating stage of unusual severity, or may run on into an asthenic or excessively debilitated condition of the system, with more or less continuous fever of a low type, which, with night sweats and uncontrollable restlessness, may engender hectic fever, or, by developing jaundice and dropsy from chronic disorder of the liver and kidneys, may progress to a fatal result.

*Treatment.*—The treatment of remittent fever, depending as it does, at least in part, upon the presence of the malarial germ in the system, must obviously consist largely of the administration of quinine, as the specific antagonist of the ague poison. It has been suggested that the real difference between remittent and intermittent fever lies in the circumstance that the former is complicated with an inflamed condition of the stomach and upper portion of the intestine. Be that as it may, the fact remains that disturbance of the stomach and derangement of the liver, perhaps largely sympathetic, requires treatment, and it is therefore advisable to commence

with a dose of from five to ten grains of blue-pill or calomel, to relieve the pressure on the liver by an overplus of bile, which, if not purged off by the mercurial, would be again taken up in the lower bowel and added anew to the hepatic load. This elimination of an excess of the bile may relieve the obstinate vomiting sufficiently to allow the patient to keep down ten, fifteen, or twenty grains of quinine during the next remission, and so enable us to break up the attack. If the sick man is unable to retain full doses, on account of the gastric disturbance, quinine may be employed by way of an injection, dissolved in a couple of table-spoonfuls of flaxseed-tea or of thin starch. A more elegant method is to give it contained in a suppository of cocoa-nut butter in the usual form. When administered thus by the rectum, it is usually necessary to increase the dose at least one-half in order to obtain the same effect. The symptoms during the paroxysm may require treatment until the disease itself is controlled by the antiperiodic. Headache and fever can be combatted by cold applications to the head, and cool sponging, or even hypodermic injections of morphia if the pain in the head is very severe. The fever mixture, composed of sweet spirits of nitre and bromide of potassium or ammonium, already recommended in the article upon Small-pox, may also be employed. Obstinate vomiting can sometimes be checked by small quantities, such as dessert-spoonful doses, of lime-water and milk, cold carbonic acid water, five grains of bismuth, a drop of diluted hydrocyanic acid, or one drop doses of the wine of ipecacuanha.

A remittent fever may begin with intermittent, and, as it passes off under treatment or otherwise, it sometimes resumes the intermittent type, leaving the patient for a large portion of the day entirely free from fever.

### TYPHO-MALARIAL FEVER.

This form of disease is described as being produced by a compound of the poisons of remittent and typhoid fever, both acting upon the system at the same time. The term was introduced by the lamented Dr. Woodward, U. S. A., and admirably characterizes the peculiarly complicated disturbance of health to which it is applied. The symptoms at first are chiefly those of the malarial element, such as an onset with chill or marked shivering, intense headache, vomiting, and yellowness of the skin, the temperature during the exacerbation rapidly rising to a high degree the first evening of the attack, instead of becoming gradually elevated, as is usually the case in uncomplicated typhoid. If after a few days the remittent element is controlled by full doses of quinine, the symptoms of typhoid fever, including the diarrhoea, rose-colored spots, and tympanitic distension of the abdomen, are usually observed; and if, during convalescence, the malarial element is not held in check by a continuance of the antiperiodic treatment, exacerbations and remissions of remittent or of intermittent fever are very apt to recur.

The diagnosis of this form of the disease will rarely be attended with much difficulty after a few days are allowed to elapse, so as to permit the characteristic symptoms to develop. The only point necessary to keep in view, in managing a case of either remittent or typhoid fever, which presents unusual symptoms, is the possibility that the germs of these two diseases may co-exist in the same human body, and conspire together, though each working in its own peculiar mode, to disturb the integrity of organization and of function. Some aid in doubtful cases may be derived, on the one hand, from the fact that the patient has been exposed to the influence of malaria, and on the other, that there has been a possibility of typhoid infection from polluted drinking water or contaminated air.

In the series of cases first observed by Dr. Woodward among the Federal troops, during the great civil war, a well-defined scorbutic element was noticed; but this further complication with scurvy is, of course, not likely to occur in civil life, and if threatened could easily be avoided by proper attention to diet, as will be pointed out when the subject of Scurvy is discussed.

### PERNICIOUS MALARIAL FEVER.

Under this name have been described the very fatal forms met with in the Southern States, and still more frequently in Central America and other torrid parts of the malarial zone. Although rarely seen north of the Gulf States, this form of the disease merits a brief notice.

Pernicious malarial fever differs in no respect from ordinary ague and bilious remittent, except in its greater severity. The disease is observed under five forms. In the first, called the *comatose* or apoplectiform, the patient speedily loses consciousness, as though the chief force of the poison was expended upon the brain, disturbing its functions to such an extent as almost to abolish them. In a second variety, called the *spasmodic*, violent convulsions, resembling those seen in epilepsy and hydrophobia, may be produced. In the third or *algid* form, the symptoms of intense chill are prolonged, it may be for some hours, and death occurs in fatal cases from pure debility or asthenia, without reaction coming on. Although the patient is apathetic, the mind remains clear to the last. In cases of the *choleraic* type, vomiting and purging are the prominent symptoms, and the disease might readily be mistaken for Asiatic cholera, if it happened to occur whilst an epidemic of that malady was raging, were it not that the urine is never albuminous. In the fifth group of cases, denominated *hemorrhagic* malarial fever, the prominent peculiarity is bleeding, generally from the kidneys, but sometimes from the stomach, bowels, nose, and mouth.

The diagnosis of pernicious malarial fever is often difficult, and at the



same time exceedingly important, because the life of the patient may depend upon its prompt and accurate recognition. In most cases the attacks of this dangerous affection are preceded by one, two, or three paroxysms of ordinary or severe ague or remittent fever, so that some warning is afforded by the history of the case. As there is no reliable indication of the approaching onset of the pernicious form, the prudent way is, in all hot climates, to treat every case of a paroxysmal fever as if the next one might assume a fatal intensity. When an attack of pernicious fever does not cause death, the passing off of the more dangerous symptoms, after a few hours, usually affords a clue to the true nature of the onset, and the proper remedies should at once be administered, in order, if possible, to prevent another paroxysm, which would almost certainly destroy the life of the patient.

*Treatment.*—In treating a case of pernicious intermittent fever, during the paroxysm, the prominent symptoms are to receive especial attention; for instance, in the choleraic variety, a grain or two of opium by the mouth, or from one-sixth to one-half a grain of morphia hypodermically, should be given. As soon as the patient begins to improve, quinine in large doses, say of fifteen or twenty grains each, should be administered by the mouth if the stomach is retentive. If the medicine is rejected by vomiting, double the quantity should be given by enema; and, if the lower bowel also refuses it, half the dose ought to be introduced by hypodermic injection, the chance of abscess being preferred to the imminent risk of the patient's life from recurrence of the chill. As an encouragement in the use of these heroic doses of quinine, it may be mentioned that Prof. Flint records a case which came under his observation, in which one hundred and twenty grains, given in twenty-four hours, produced complete blindness and deafness. These alarming effects, however, passed away after several hours, and the preventive treatment, as regarded the pernicious fever, was successful.

### SIMPLE CHOLERA OR CHOLERA MORBUS.

This disease, defined as relaxation of the bowels with or without vomiting, occurs in almost all countries with a certain degree of seasonal regularity, generally as the direct result, in part, of errors in diet. It is marked by a copious loss of fluid from the intestinal canal, with in bad cases cramps, or spasms in the bowels and in the limbs, and coldness of the body, followed during recovery by a fever of reaction. This malady, which is not contagious, occurs at times almost as an epidemic, and is occasionally fatal, so that no instance of it, however mild at first, ought to be allowed to run on without treatment. Although generally induced by indulgence in indigestible food, especially unripe fruits, there seems to be at certain seasons of the year some external influence promoting

the tendency to disorder of the bowels, which is probably atmospheric, although even this has not yet been positively determined. Occasionally attacks of this kind appear to be brought on by taking cold, from checking perspiration, or otherwise, which affects the lining mucous membrane of the intestines, setting up an acute catarrhal inflammation of the stomach as well. The primary symptoms are uneasiness at the pit of the stomach, nausea, retching, and then vomiting, followed by severe watery diarrhoea, consisting of a large amount of the watery portions of the blood, and containing only a little albumen. The whole system is thus affected, in part by sympathy, but also to some extent, it is probable, by the change in the specific gravity and constitution of the blood. The attack is often abrupt, a patient being awakened out of sleep by a sudden seizure during the night. This is, however, no doubt because the preliminary uneasiness, nausea, and slight colicky pains, which manifest themselves in a diurnal onset of the malady, are unfelt in the unconsciousness of profound slumber. The vomiting and purging, when once commenced, recur in rapid succession, and sometimes even simultaneously, and enormous quantities of fluid are evacuated from the system, often with the result of producing intense thirst. This thirst cannot, however, be gratified for some time, because the irritable stomach refuses to retain the smallest amount of fluid.

The only difficulty about the diagnosis of cholera morbus, or sporadic cholera, is when true Asiatic cholera is epidemic, or expected to become so. Ordinarily the prompt yielding of the disease to proper treatment, and the speedy recovery and resumption of the digestive powers, even although the symptoms for a short time were exceedingly alarming, demonstrates the presence of the mild and almost innocent disease. After nature, in her wonderful wisdom, has emptied out from the alimentary canal all the injurious materials which have been foisted upon her as food, she must at once be prevented from going on, as she may do in her equally wonderful stupidity, with the vomiting and purging, which are no longer needful, and only cause pain and debility to the patient. For this purpose a mixture containing in each dose ten drops of laudanum, twenty drops of compound spirits of lavender, a drop of chloroform, and five grains of bismuth, is highly serviceable, if the stomach can retain it, or, if that organ prove rebellious, an enema of twenty-five drops of laudanum in a table-spoonful of thin starch should be given, and if not rejected will almost certainly afford great relief. If both these methods fail to yield us access to the system, it may be necessary to have recourse to the hypodermic injection of morphia in quarter of a grain doses, by which the malady may, in almost every instance, be promptly controlled.

*Diet.*—Little can be said in regard to the dietetic management of cholera morbus during the attack, but as a preventive measure attention to diet is of the greatest importance. Whenever autumnal cholera becomes

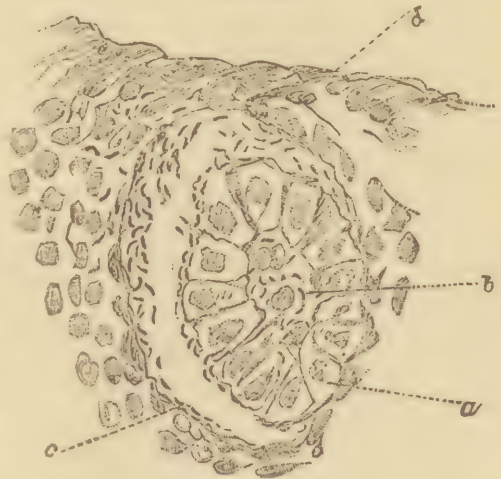


prevalent, it is prudent to avoid all fruits, and even the ordinary vegetables, but particularly Indian corn, cucumbers, boiled cabbage, melons, and similar indigestible articles of diet. The meals ought to be restricted to animal food, in a perfectly sound state, boiled milk, well boiled pure water, bread and rice; and if any symptoms of derangement of the bowels appear, rice should at once be omitted, toast should be eaten instead of bread, and tea or boiled water, with or without the boiled milk, used as beverages. Among children, especially children in large cities, who die by scores every year from cholera infantum, attention to these simple precautions would be of immense service, as will be pointed out more minutely in the section on diseases of children.

### MALIGNANT OR ASIATIC CHOLERA.

This dreaded malady, called also spasmodic cholera, and true or genuine cholera, is defined as an epidemic disease characterized by vomiting and purging, with evacuations like rice-water, accompanied by cramps, and resulting in suppression of urine and collapse. The disease-poison of cholera undoubtedly reproduces and multiplies itself during the course of the complaint, being propagated by a contagion, given off mainly, if not entirely, by the evacuations from the bowels, in which the germs of disease propagate themselves, even after their discharge; so that the stools become more virulent after they are passed, especially when mixed with water. The extended researches of Dr. Koch, so famous for his discovery of the fungus or bacillus causing consumption, which have been carried on so diligently in India, in Egypt, and more recently in Toulon, have proved beyond all question the existence of the cholera germ in drinking water, and traced its development in the intestines of persons who had died of the disease.

FIG. 30.



THE CHOLERA GERM.

The illustration in the margin shows the appearance of this cholera germ, which it is so important for every one at the peril of his life to avoid. When magnified about six hundred diameters one of the minute intestinal glands, described on page 147, may be found to contain, as shown at *a*, *b*, and *c*, minute bacteria or bacilli, as they are technically called, which, from their resemblance to the curved portion of a comma, but without



the head of that punctuation mark, have been named the *Comma bacilli*. Sometimes these bacilli unite at their ends with their curves turned in opposite directions, so as to produce an S shape, or even a spiral formation. This *Comma bacillus* appears to be the direct cause of cholera by its lodgment in the intestines, where it has been proved, by examination of nearly one hundred cases, to develop with great rapidity. It is easiest to detect in the earlier stages of the disease, because later on it is obscured by the development of a great many other forms of bacteria. It is distinctive of the mildest as well as of the most severe attacks, and has therefore an important diagnostic value. It is capable of successful cultivation in meat broth, in milk, on slices of potato, and especially on gelatine, in which it grows in a singular manner, producing a gradual liquefaction of the stiff gelatine around the growing colony, which sinks down into the jelly in a peculiar way. The comma bacillus thrives best at temperatures between 70° and 135° Fahrenheit, but is not destroyed and only has its growth checked by a cold of eighteen degrees below the freezing point. It is, however, readily killed by drying, by the removal of all animal material upon which it can feed, or by acidifying the medium in which it is growing with a mineral acid. Under ordinary circumstances the bacillus when swallowed is destroyed by the gastric juice, being digested in the stomach, but when there is any derangement of the stomach, from errors of diet or any other cause, so that the acid digestive liquid is deficient or absent, the bacillus escapes destruction, and may pass on into the intestine where the fluids are alkaline and it is able to develop with great rapidity. This fact in regard to the growth of the bacillus in alkaline fluids solely is one of great importance, not only in regard to the treatment of cholera, but also in connection with the subject of diet, since it is obviously highly necessary to avoid everything which, by producing indigestion, could interfere with the production of the precious gastric juice, which seems to have been intended to act as a guardian against the entrance of the comma bacillus, as well as many other disease germs. Although the bacillus has a certain effect as a local irritant, its chief harmful influence is very likely through some chemical poison which it generates during its process of growth. This is indicated by the results of some experiments upon pigs, which being fed with the discharges from cholera patients in the acute stage, died in convulsions from fifteen minutes to two hours and a half afterwards, a period of time too short for the development of the bacilli in sufficient numbers to prove fatal. In cholera epidemics we have, says Dr. Koch, instances amounting to actual experimental infection of man, as, for example, in the infection of those engaged in washing linen soiled with the discharges from the bowels of patients affected with cholera. An event of this kind is reported in the first outbreak of cholera in this country, when it was introduced into Quebec forty-two years ago. Linen or other clothing soiled with choleraic dis-

charges contains the bacilli often in a pure form, and if infection occur through this medium it must be by the comma bacilli, frequently the only microscopic organism present, except those which are known to be innocent. The hands of a person washing or handling such clothes may be soiled, and the bacilli introduced into the mouth by direct contact, or through the food which thus becomes contaminated, or the washing water may come in contact with the lips, and thus in some way the human being be fed with an extremely minute quantity of a pure culture of the comma bacillus. When Dr. Koch, was investigating the disease in India, he observed an instance in which a certain tank furnished the water for drinking and other purposes to many people among whom the cholera was raging. He found the comma bacilli in this tank, and learned on inquiry that the clothes of the patients were washed in it. Around the tank were some thirty or forty huts inhabited by upwards of two hundred people, and of these persons seventeen died, whilst the number of those taken sick was not ascertained. The tank in this case also received the refuse from the dwellings. In fact, it is common in India for the Hindoos to bathe in the tank which affords their water-supply, to wash their utensils in it, to deposit their excrement upon its bank, and if a hut has a latrine, or substitute for one, its outflow is apt to be into the tank. In this particular instance it was found, after a time, that the bacilli became less abundant in the tank-water, and coincidentally the cholera declined among the inhabitants of the huts along its shore. Here if the epidemic had been the cause of the bacilli, instead of the result of their development, the number of these minute organisms ought to have been augmented after the disease began to be less violent.

Supposing, then, as seems highly probable, that the *Comma bacillus*, as it grows in the human intestine, produces a specific chemical poison, just as the cells of the poppy-plant during their growth produce the powerful poison morphia, the symptoms of cholera are thus explained by Dr. Koch. The virulent material acts locally upon the mucous membrane of the intestine, in the neighborhood where it is formed, destroying its texture, and being also absorbed, acts likewise upon the general system, and especially paralyzes the circulatory organs. All the symptoms of cholera, which have usually been explained as being due to a loss of water and consequent thickening of the blood, are explicable upon this view. Death may occur in this early stage of cholera poisoning when but few local changes are found, and the intestinal contents exhibit a pure culture of the *Comma bacillus*. If this stage be passed through, internal hemorrhage and mortification of portions of the bowels ensue, with absorption of the putrefactive products, giving rise to the so-called cholera-typhoid. There is abundant evidence that the virus of cholera exists in the evacuations from the bowels, and rarely in the vomited matters. For further dissemination of the disease, the choleraic discharge must be retained in



a moist state, since complete drying seems to destroy the poisonous property of the virus; and this view is sustained by what we have long known in regard to the spreading of cholera by contaminated water-supply, or more directly by soiled hands, or even conveyance by insects, as, for example, by blow-flies alighting upon meat and other food. Drains may be infected, and through them the drinking water polluted; but as the virus cannot preserve its activity in a dry state, little can be hoped for from aerial disinfection, nor does it seem probable that, except under certain conditions of unusual moisture, can cholera be transmitted by merchandise or by letters, even if the latter are not disinfected, but only by human intercourse.

That the virus can be reproduced and multiplied outside the human body is now proved beyond all question, since the bacillus can be cultivated artificially, and its growth, unlike that of the fungus causing consumption, is not prevented by comparatively low temperatures. Probably it does not flourish in streams and rivers, where, owing to the current, a sufficient concentration of the nutrient substance which it requires, cannot occur; but in stagnant water and at the mouths of drains, and so forth, vegetable and animal refuse may accumulate, and afford it the necessary nourishment. Thus is explained the propagation of cholera by the subsoil-water, and the increase in the violence of epidemics with the sinking of the ground-water level, as taught by Prof. Pettenkofer, which lessens the flow and diminishes the superabundant amount of the surface-water.

Dr. Koch found that acids added to the gelatine or other material in which the cholera-germ was growing, checked its development, and that among the substances which absolutely prevented its multiplication, were alum in the proportion of one part to the hundred; camphor in the ratio of one part to three hundred; carbolic acid, one part to four hundred; oil of peppermint, one part to two thousand; sulphate of copper, one part to twenty-five hundred; quinine, one part to five thousand; and corrosive sublimate, one part to one hundred thousand. These substances, then, inversely in the order named, ought to prove efficacious as remedies in cholera, if means could only be found to bring them through the stomach unaltered, so that they could act upon the *Comma bacillus* in its seat of growth in the small intestines.

As seen in this country, cholera usually commences with a slight premonitory diarrhoea, which is remarkable for being almost entirely painless, but if this warning discharge is neglected, the patient, after a few hours or possibly a day or two, is commonly attacked quite suddenly with muscular debility, tremors, vertigo, and nausea. Spasmodic griping pains are felt, and depression of the powers of circulation and respiration come on, attended with a sense of faintness and oppression over the heart. Copious purging, at first of the contents of the intestines, and afterwards



of a thin, watery fluid, resembling water in which rice has been washed, having an alkaline reaction, and sometimes tinged red with blood, soon commences, and is usually accompanied with violent vomiting and a sensation of burning heat in the stomach. In a short time, perhaps within a few hours, there results from this excessive drain upon the circulation, coldness and dampness of the whole surface of the body, lividity of the lips, cold breath, an unquenchable thirst, a feeble rapid pulse, difficult respiration, with extreme restlessness, and suppression of the secretion of the kidneys. In fatal cases are noticed blueness of the whole body, the sunken and horror-stricken countenance denominated the Hippocratic face, popularly known as the appearance of being struck with death, and a peculiarly suppressed voice, this condition ending either immediately in fatal collapse or in reaction followed by violent secondary fever.

Cholera exists at all seasons of the year among the inhabitants of certain parts of India, which may be regarded as the natural home of the disease. It is, however, as far as our positive knowledge extends, a comparatively recent-born scourge of humanity, our first acquaintance with its deadly power dating from Madras only about one hundred years ago. In November, 1817, it suddenly appeared in the camp of the Marquis of Hastings, then engaged in the Mahratta war, and in five days caused the death of five thousand persons. From this starting-point it slowly moved both westward and eastward. In 1820 China began to suffer, and the pestilence raged there for some four years. In its westward march it reached England in the winter of 1831, and in 1832 it crossed the Atlantic, and, breaking out first at Quebec, soon spread over much of the North American continent. Cholera, therefore, had its birthplace in the East, and from thence, as a centre, spread to every point of the compass, regardless of climates, seasons, oceans, or deserts. If partially arrested by a winter's cold, the next season it often made up for its temporary delay by a new activity of propagation. Like typhoid fever, its spread is much facilitated by pre-existing conditions; its effect is aggravated when there is already a weakened state of the body, or in human beings whose systems have been undermined by previous unsanitary arrangements, bad food, or impure air. A contaminated water-supply is usually, perhaps always, an essential factor in its propagation. This has been especially urged upon the attention of the reader when the subject of Water and its Influence on Health were discussed. (See page 65.)

Cholera is, according to some high authorities, a much more communicable disease than typhoid fever, and its poison will stick to clothing, and cling to individuals, with great persistency. In one of its entrances into Great Britain it was apparently conveyed by forwarding the clothes of some dead sailors to their relatives. And yet the progress of cholera, after it does make its entrance into a district, is very capricious, and it

will sometimes march up one side of a street, neglecting the other, seize on one section of a village, sparing the rest, or even limit itself to one wing of a large building. Sometimes it attaches itself to a particular locality, for instance, as has been noticed in India, to a particular camping-ground, and by arranging the march so as to pass this spot, without resting upon it, a regiment or company may escape quite uninfected. But whatever the poison—and undoubtedly there is one—may be, its spread is facilitated by unsanitary conditions, and insured by any contamination of the water-supply with the rice-water discharges.

The views of Pettenkofer, the famous professor of Hygiene in Munich, as to the concurrent circumstances, requisite for the development of a cholera epidemic are that there must be, first, a layer of inhabited soil pervious to both air and water, to a certain considerable depth; second, an alteration from time to time of decided extent, in the moisture of this layer, which is most easily effected, by the changing condition of the ground-water in alluvial soils, the time of danger of an outbreak of cholera, being that at which the ground-water settles down from an unusual height; third, the presence of organic matter, particularly excrementitious matter, which has permeated the layer of soil to a point at or near the level of the ground-water; fourth, the specific germ spread by human intercourse, and constituting the specific cause of cholera, chiefly conveyed by the intestinal discharges, of patients suffering from choleraic diarrhœa, and which may even be carried by healthy persons coming from infected places; lastly, fifth, a predisposition in the individual to suffer from cholera. Pettenkofer's opinion is that sanitary science should endeavor to combat an epidemic, in the first place by diminishing the influence of human intercourse, and so preventing the introduction of the cholera germ, which is, however, difficult; or, in the second place, by correcting the state of the soil and the ground-water it contains, thus counteracting the predisposition to development of the cholera germ; or, thirdly, by rectifying the individual predisposition which arises from the condition of the human body. Of these methods, the second offers the best field for a systematic prophylaxis on the part of the state and the community, as is shown by the success in obstructing the spread of the disease in some English towns and in New York City. Drainage and good drinking water, by preventing the soil upon which a town stands from being permeated by refuse, and also by averting excessive fluctuations in its ground-water, break one of the most important links in Pettenkofer's chain of causes effecting the development of cholera, and so cut short the development of that malady. In conclusion, Professor Pettenkofer remarks that intercourse may be looked upon as the slow match which carries the virus of the epidemic, and that the danger is proportioned to the amount of locally accumulated explosive material, without a magazine of which the match would be harmlessly extin-



guished. Direct your chief attention, he exclaims, to that material, and not to the almost impossible task of hunting after sparks carried along by traffic.

The course of cholera during the last epidemic which visited the United States, and ravaged the Mississippi Valley in 1873, reaffirmed the lessons of previous outbreaks of this disease abroad. This was especially the case as regards the supreme importance of pure water-supplies in cities and villages, and of having all wells and water-springs which are used by the people effectually guarded against any possible soakage and contamination from privies and other sources of defilement by excrement. It must be admitted that the history of outbreaks of cholera, in all parts of the world, conspicuously illustrates the vital importance of procuring all supplies of drinking-water from sources which cannot become polluted by the soakage into them of intestinal discharges, or from outflowings in any such way as to be carriers of bowel-diseases, particularly not of cholera and typhoid fever. The story of the Broad-street pump in London, which killed five hundred people in one week during the last great cholera epidemic, and was found to have its water contaminated by soakage of cholera evacuations from an adjoining cess-pool, has already been related (see page 65), but it should be retold to every one as a terrible warning against the almost universal dangers of water-pollution. An item in the London *Lancet*, printed in 1882, states that a recent analysis of the water of the Holy Well of Mecca, which is so eagerly drunk by the pilgrims, as a part of their religious rites, shows the water to be sewage, about ten times stronger than the average London sewage. And during the same month that this report was given, came the news that the cholera had made its usual annual appearance among the pilgrims to the shrine of Mahomet in the Holy City of Mecca. It therefore appears extremely probable that by suitable investigation of the water of the Holy Well, there might be found in it a perennial supply of the cholera-germs, and such a demonstration of the true origin of the frightful cholera epidemics which, spread by the caravans of returning Moslem pilgrims, have so often devastated large sections of Europe and Asia, would be a triumph for experimental hygiene of which the whole world of science might be proud.

The impurity of the local atmosphere of a dwelling, a village, or a particular district, is proved to be a matter also of public concern, and environed in a polluted atmosphere, the palatial mansions of wealth and gayety may suffer equally with the tenements of the humblest classes. The specific migratory power of cholera, whatever its nature, has the faculty of infecting districts in a manner most detrimental to health only when the atmosphere is fraught with certain products, susceptible under its influence of undergoing poisonous transformations. Through the unpolluted atmosphere of cleanly districts it migrates perhaps without a blow, because that which it can kindle into poison is not there.



The utility of disinfectants as preventives of cholera depends partly upon their power to neutralize and destroy the essential cause of cholera—that is, its infective attribute or poisonous germ—and partly upon their antiseptic effect in preventing putrefaction and in decomposing the foul products of decay and putrescence. Upon this subject no rational doubt longer exists. This utility of disinfectants and the relative usefulness of different agents for these purposes are demonstrated facts (see pages 289 and 296); but the effectiveness and sanitary value of any or all the materials employed in disinfection depends upon the exact fitness, the sufficiency, the thoroughness, and the timeliness of their application. Much that passes for disinfection and sanitary cleansing are such only in name. In these sanitary acts and duties nothing is more true than the maxim, “What is worth doing at all, is worth doing well.”

Vigilance in sanitary measures, and the employment of disinfecting agents in anticipation of danger, proved pre-eminently successful in preventing cholera from gaining a foothold in New York city in 1867 and 1868, although it prevailed in different parts of Europe and America in those years. Even after this terrible disease has gained an entrance into a community, it may be “stamped out” by disinfecting agents. From the reports of the New York City Board of Health, we find that in 1866 more than a thousand cases of cholera occurred in numerous localities, more or less widely separated, and in order to prevent the spread of the malady a well-appointed disinfecting corps was organized, which might respond instantly to any call either day or night. They were provided with every requisite and means of transportation to secure immediate service, and the beneficial effect is shown in the statement that in three hundred and sixty-two New York houses, where individual families or persons were smitten by cholera, but which were promptly brought under full sanitary control by disinfection and local purification, the pestilence did not extend beyond the family in which the first case occurred.

The improved system adopted in the latest threatened epidemic was as follows: The process of disinfection consisted in putting sulphate of iron, the ordinary green copperas, either in saturated solution or dry if used in wet places, in privies, in all utensils containing evacuations from the bowels, and in all places where such evacuations had been deposited. An ordinary privy, six feet in diameter, and twelve feet deep, required twenty pounds of sulphate of iron for its thorough disinfection. All bedding soiled or used by the patient was boiled in a solution of permanganate of potassa, of the strength of one ounce of the chemical to five gallons of water, for two hours; then removed and reboiled in pure water. For purifying the atmosphere of the room without inconveniencing the patient chlorine was gradually set free by adding sulphuric acid to a mixture of binoxide of manganese and chloride of sodium. In addition to these measures, chloride of lime, or Labarraque's solution of chlorinated soda,

was scattered freely about the rooms and walls of the house. Wherever one or more cases appeared a second time in tenement houses, occupied by several families, special precautions for the thorough fumigation of the premises with chlorine or with sulphurous acid gas, were instituted. For this purpose all tenants were removed from the building, being allowed to take with them nothing more than the clothing worn at the time. The windows and chimneys were then all closed, and the disinfecting gas was set free in abundance; if chlorine, by the addition of sulphuric acid to chloride of lime; if sulphurous acid, by the burning of sulphur in large open pans, supported on long iron legs. The men employed commenced the process in the upper stories, and descended, leaving the pans in operation on the different floors, and finally closed the street door. The house, thus filled with the gas, was left undisturbed for from eight to twelve hours; it was then opened, freely aired, and finally the tenants allowed to reoccupy it. In accordance with the investigations of Dr. Koch and others, upon the power of various chemicals in repressing the growth of the *Comma bacillus* which constitutes the cholera germ, solution of sulphate of copper or blue vitriol of the strength of half a pound in a gallon of water is now recommended as the best disinfectant for the discharges from the bowels.

*Treatment.*—The successful treatment of cholera depends largely upon how promptly remedial measures are commenced, for if the first sign of relaxation of the bowels is met at once by an energetic astringent and opiate, such as the mixture of a tea-spoonful of syrup of galls, ten drops of laudanum, and one drop of chloroform, repeated every hour if necessary, or a compound of ten drops each of tincture of camphor, of capsicum and laudanum, to which, if there is any vomiting, five grains of bismuth should be added, it is certain that many lives might be directly saved by medical treatment. Sometimes a pill of opium and acetate of lead, with a little capsicum, using, for example, one-half of a grain of opium, two grains of the sugar of lead, and a quarter of a grain of cayenne pepper, is singularly serviceable, and being carried in small compass, is especially convenient for travellers. The temptation to neglect the preliminary stage of cholera is very great, because the diarrhoea is so entirely painless, that it seems hard to realize a slight disorder of the bowel can possibly be the commencement of such a terrible disease, which may prove fatal, with agonizing sufferings, only twelve or eighteen hours later. Such, however, has often been the case, and whenever there is any suspicion of the cholera germ being in the neighborhood, choleric or choleraic diarrhoea should receive the most prompt and effectual treatment which it is possible to administer. After the severe symptoms set in, the vomiting is generally so violent that neither food nor medicine can be kept on the stomach, and since the purging is at least equally incessant, we are usually precluded from resorting to the administration of remedies by



enema. Under such circumstances the hypodermic injection appears at first sight to afford the best means of medication, but experience has shown that the narcotic effect, so valuable in many instances, seems to hasten in cholera the advent of that stupor or coma in which death so frequently occurs. The best plan is probably, therefore, that of Prof. Flint, who recommends that from half a grain to a grain of the sulphate or acetate of morphia be placed dry upon the tongue and allowed to make its way down the throat with the saliva of the patient, some of it no doubt being absorbed by the mucous membrane even before it reaches the stomach. This simple treatment, with the application of mustard plasters over the stomach, and dry heat from hot-water bottles, hot-water bags, or even hot bricks, if the surface of the body is very much chilled, is to be recommended in most instances where the stomach and intestines are so excited and irritable as to reject other medicines, and the increased vomiting and purging thereby provoked only further exhausts the patient's scanty stock of strength. In accordance with Dr. Koch's experiments upon the growth of the cholera bacillus, much may be hoped from diluted nitric acid in three-drop doses, and from corrosive sublimate in quantities of one-twelfth of a grain.

*Nursing*.—The nursing of severe attacks of cholera consists chiefly in keeping the sufferer as quiet and as clean as possible, and refraining from the supply of cold drinks, which, no matter how urgently called for, should be withheld during the stage of acute vomiting. As soon as the period of collapse is passed through, which may be known by the diminution or cessation of the discharges from the bowels, and the partial return of warmth and color to the face, hands, and feet, small quantities of ice, iced milk with lime-water, or iced champagne, may be cautiously ventured, and after the power of retaining food is assured, cool water with a little salt and carbonate of soda, for the purpose of replacing the saline ingredients of the blood which have been lost so rapidly in the copious rice-water discharges from the intestines, should be administered in small quantities frequently repeated. The typhoid symptoms which are apt to appear in the reaction from the collapse of cholera, must be managed according to the principles laid down in the article on Typhoid Fever. (See page 328.)

The personal prophylaxis in cholera is very important. Only the most unirritating and non-laxative food should be used, and water which has been carefully boiled for five hours, and then kept secluded from the air, ought to be the only drink. Purification of the atmosphere may be sought for by the use of chlorine and sulphurous acid, but the best private precaution is to depart at once from the infected district, and in these days of fast express trains it is easy to outstrip the enemy, and put so many hundreds or even thousands of miles of cold, pure air and water between oneself and the cholera germs, that comparative safety can almost certainly be secured. In such a flight, however, every precaution ought to



be taken to avoid infecting other localities, and at the same time defeating the very object of the change of climate, by carrying along the cholera poison in clothes and baggage, as has no doubt very frequently been done. To avoid this the admirable methods carried out by the New York Board of Health for disinfection of apartments, contained garments, and so forth, or those recommended when speaking of contagion on page 290, should always be resorted to.

### DIPHTHERIA OR DIPHTHERITIC FEVER.

This fatal complaint is also the result of a powerful disease-poison, reproduced and multiplied in the system during the course of the illness, which is characterized by the formation of a membranous exudation on some of the mucous surfaces, generally that of the throat, mouth, nose, or air passages. The same false membrane, as it is commonly called, may, however, develop upon the surface of any wound or abraded surface, such as the raw skin of a blister, showing, it is thought, that the malady is not merely a local one, but a constitutional disease affecting the whole system. The general symptoms are extreme prostration, nausea, and vomiting, pain in the stomach, and sometimes pain in the back. In a large proportion of instances of the severe form, albumen appears in the urine early in the attack. Diphtheria is highly contagious, but differs from the other contagious diseases, which have been described in this chapter, in the fact that an attack of the malady affords no protection against subsequent ones. In fact, for a time at least, the patient who recovers from a severe form of diphtheria often finds himself more susceptible than before, to the complaint. Indeed, it has occurred in the author's own experience, that a young lady after recovering from severe diphtheria sufficiently to aid in nursing a sister who had contracted the disease from her, took the same complaint in a still more aggravated form from this sister again, and died of it after three days illness. A remarkable characteristic of diphtheria, and one which serves to distinguish it from affections such as croup and malignant scarlet fever, with which it has been and still is by some confounded, is the tendency to produce various forms of paralysis, which, however serious they are for the time, seldom or never prove permanent.

Diphtheria is very apt under certain unknown conditions to become mildly or sometimes virulently epidemic, and in such instances either the general, that is the constitutional, or the local symptoms may predominate. Sometimes the patient may die from the violence of the febrile attack, or in other cases death may be due to the mechanical obstruction to respiration, as in diphtheritic croup, or lastly the fatal result may be effected directly or indirectly by prostration arising from the profound effect of the disease-poison upon the blood.

As ordinarily seen in the United States, there is in diphtheria first a

slight redness and feeling of soreness in the throat, generally upon one or both tonsils, and on careful examination the tonsils and adjacent portions of the fauces are found to be a little swelled. A whitish-grey patch of false membrane, looking at first like a small ulcer in the mucous surface, next makes its appearance, and this may spread, uniting with the exudation from other starting points, until the whole interior of the throat, in bad cases, is covered with it. If this false membrane is forcibly torn away, as, for example, by some of the various forceps which were at first invented for the purpose, a raw bleeding surface is exposed, which in a few hours is again covered with a new growth of the layer of membrane. This structure, which is partly composed of an exudation of lymph, and partly of a fungoid growth, the micrococcus diphtheriticus, quickly undergoes putrefactive changes, together with the outer layer of mucous membrane lying immediately beneath it, so that there is often a superficial ulceration, from which an unhealthy discharge flows, and a putrid odor frequently emanates constantly, in severe cases of diphtheria. The thickness and density of the false membrane varies greatly in different cases, and in different epidemics. Sometimes it is scarcely thicker than writing-paper, and has hardly more consistence than thick cream. At other times it is firm and tough, almost like leather, and may even attain the thickness of a quarter of an inch. Although in mild cases and those of moderate severity, its color is grayish white, in debilitated states of the system, and when there is a tendency to bleeding from the throat and other mucous surfaces, it may be tinged, probably by the altered blood elements of a yellow, yellowish-brown, or dark brown hue. The extension of the false membrane is unfortunately by no means limited to the fauces, but may progress upward into the cavities of the nose, or downward into the larynx and trachea, when its formation constitutes the essential condition of diphtheritic croup, a type of the malady apt to be extremely fatal.

The diagnosis of diphtheria is surrounded with many difficulties, the greatest of which is that arising from a want of agreement as to what symptoms constitute the genuine disease. Without entering into the disputes among physicians in regard to this point, which would be manifestly out of place here, it is sufficient to state that, for the purpose of insuring proper sanitary precautions, it is advisable to consider all cases of sore throat, with fever and prostration of strength, in which patches of false membrane, however small, appear upon the tonsils or fauces, as diphtheritic in their character. This arrangement will include a large number of cases denominated diphtheritic sore throat, pharyngitis, and simple sore throat, which are by many physicians looked upon as entirely non-infectious. Nevertheless there can be little doubt that such a course of procedure does favor the extension of epidemics of diphtheria in some, perhaps in many, instances, and therefore, from a sanitary point of view,



it is a highly erroneous one. In accordance with the more comprehensive classification, the appended regulations for the prevention and restriction of diphtheria, drawn up by the author, and adopted by the Philadelphia Board of Health, are worthy of close attention whenever a severe form of the disease is prevalent, or threatens to become so.

Recent investigations having proved that the poison of diphtheria is portable, communicable by infection, and capable of reproducing itself outside of the human body, diphtheria must now be ranked as both a contagious and infectious disease. The following rules are therefore more imperative than ever before :

1. When a child or young person has a sore throat, a bad odor to its breath, and especially if it has fever, it should immediately be separated and kept secluded from all other persons, except necessary attendants, until it be ascertained whether or not it has diphtheria, or some other communicable disease.

2. Every person known to be sick with diphtheria should be promptly and *effectually isolated* from the public. Only those persons who are actually necessary should have charge of or visit the patient, and these visitors should be restricted in their intercourse with other individuals. Children residing in a house where there is a case of diphtheria should *not* be permitted to attend school.

3. When a case of diphtheria is fully developed, the same precautions in regard to free ventilation, disposal and disinfection of discharges, bed or body linen, and so forth, isolation during convalescence (or management of the corpse should death unfortunately occur), and so forth, ought to be enforced which have already been recommended in regard to small-pox.

4. It is particularly important that persons whose throats are tender or sore from any cause, should avoid possible exposure to the contagion of diphtheria. Children under ten years of age are in much greater danger of taking the disease, and after they do take it of dying from it, than are grown persons. But adults are not exempt, and mild cases in them may cause whole series of fatal attacks among children.

5. Numerous instances are recorded where the contagion of diphtheria has retained its virulence for weeks or months, in cesspools, heaps of decaying vegetable matter, damp walls, and so forth, and been carried for long distances in clothing, in sewers, in waste pipes from stationary wash-stands, and in other conduits. Hence all sewer connections and other carriers of filth should be well ventilated and disinfected, and children particularly should not be allowed to breathe the air of any water-closet, cesspool, or sewer into which discharges from patients sick with diphtheria have entered, nor to drink water or milk which has been exposed to such air or the atmosphere of the sick-room.

6. Beware of any person who has a sore throat; do not kiss such a person or take his or her breath; do not drink from the same cup, blow the same whistle, nor put his pencil or pen into your mouth.



7. Do not wear nor handle clothing which has been worn by a person during sickness or convalescence from diphtheria.

*Treatment.*—The treatment of diphtheria has undergone several changes during the past twenty-five years, and many of the so-called “specifics,” vaunted for a time as being all-powerful in this dreaded malady, have sunk in a well-merited oblivion. The weight of opinion in the medical profession at the present time, is decidedly against the employment of the strong caustic solutions, formerly so much in vogue. Gargling or, what is preferable, the use of solutions of alum, half an ounce to half a pint of water, with a table-spoonful of paregoric or of chlorate of potash, and of permanganate of potash, in the form of a fine spray, as produced by the steam atomizer, are undoubtedly beneficial, and when the disease takes on the form of diphtheritic croup, atomized lime-water has been probably more successful than any other remedy. For adults, and children who are old enough to submit to the painting of the fauces with a camel’s-hair brush, without a contest, or at least a combat, solutions of Monsel salt, of the tincture of chloride of iron, and tannin in glycerine, are highly recommended by some practitioners. Internally, solutions of chlorate of potash strong enough to give five grains every two hours, or chlorate of potash with fifteen drops of the tincture of chloride of iron, with or without the addition of glycerine or honey, are largely employed and apparently in many cases with great benefit. Calomel in huge doses of thirty grains has of late been strongly urged, and constantly sucking ice gives relief and probably has some curative tendency. In severe cases of diphtheria, earlier perhaps than in most other prostrating maladies, supporting treatment becomes necessary, and alcohol should be all the more freely given, because, according to certain authors, it has a directly destructive effect upon the germs of this disease. Quinine, if the stomach is retentive, should be administered in full doses of twelve or fifteen grains daily to aid in sustaining the powers of life.

In the numerous instances when diphtheritic croup threatens to prove fatal, it soon becomes a very serious question whether opening the throat below the seat of obstruction, called the operation of tracheotomy, shall be done. As the prospect of agonizing death, when the larynx is plugged up, as happens in this affection just as it does in true croup, is almost certain, and tracheotomy, although dangerous, both in itself and still more in its results of pneumonia and bronchitis, is found to save nearly one out of three patients, it should always be resorted to unless, in the opinion of the attending physician, there are some unusual circumstances which render it inapplicable.

*Nursing.*—Special points in the nursing of diphtheritic cases, are the regular administration of supporting medicines, the avoidance of any muscular exertion which can possibly be avoided, and the watchful care against taking cold by exposure to draughts. Even after convalescence appears

to be fairly established, any violent exertion must be scrupulously shunned, as is indicated by the instructive case recorded of a patient, who, when asked to allow the doctor to examine her throat, felt so much better that she sat up in bed quickly, without assistance, and almost immediately fell back in a fainting fit, caused by the sudden exertion, from which she could not be revived.

In the diphtheritic paralysis which often comes on just as the patient begins to think he is safely through with the attack, good nursing is all-important, as medical treatment seems to have but little effect, and most cases recover completely after some weeks or months, if properly attended to. If the paralysis is in its usual seat, the muscles of the pharynx, and swallowing becomes difficult or impossible, the patient must be nourished either through a stomach-tube passed down the throat, or by nutritive enemata in the manner already described. Should the lower limbs be affected, besides fresh air, tonics, and good food, careful bathing and vigilance against bedsores are required.

### HOOPING COUGH OR PERTUSSIS.

This affection begins as an ordinary cold or catarrh, but after a few days or a week, develops into fits of spasmodic cough, which gradually become convulsive in their violence. These paroxysms consist of numerous, short, rapid, spasmodic efforts, at forcible expiration, followed when the breath seems entirely exhausted by a prolonged and deep inspiration, marked by a characteristic sound, commonly known as the "hoop" or "whoop." The sounds are apt to recur several times before the fit ends, and then a quantity of mucus is brought up from the lungs or stomach, or, especially at the height of the disease, the contents of the stomach are evacuated by vomiting. This complaint is highly contagious, and easily caught by one child from another, by their merely being in the room together. Fortunately it is one of those diseases which do not occur, as a rule, twice in the same person and hence it is rare except among children, who receive the infection whilst quite young, and afterwards are protected through life. The contagion of hooping cough appears to be produced abundantly before the characteristic hoop manifests itself, as numerous examples of conveyance of the disease whilst in the early stages are met with. The period of incubation of hooping cough is from five to eight days, although if the time is counted until the hoop begins the duration would be often about two weeks. The entire duration of the cough varies from six weeks to three months. A good deal depends upon the season of the year, for an attack of hooping cough commencing in the early fall is apt to last through the winter, whilst if the onset of the disease takes place in the spring it is often lost after a comparatively short period as warm weather arrives. It seems to have a peculiar tendency to develop in conjunction

with the eruptive fevers, especially measles, and when it proves fatal, as it does occasionally, particularly in young children, it is liable to do so by promoting the development of capillary bronchitis. It is not common, however, for the complaint to be contracted by an infant before it is weaned. The number of paroxysms occurring in each twenty-four hours varies with the severity of the attack, and they are more apt to come on during the night than in the day-time. In severe cases the fits may number eighty or a hundred daily, whilst in mild attacks the limit of five or ten will perhaps not be exceeded.

The diagnosis of whooping cough, until after the hoop is once heard, is impossible, but it may be suspected in a child who, after being exposed to the contagion, takes cold, and has a prolonged cough which is rather more spasmodic than an ordinary catarrh, and which, instead of improving as the days pass, continues to grow steadily worse.

*Treatment.*—Unfortunately we have no specific in whooping cough, such as quinine proves itself in ague, although belladonna in doses of one twenty-fourth of a grain of the extract three times a day to a child five years old often shows a marked influence in controlling the paroxysms, and so shortening the disease, which may sometimes thus be abbreviated to a duration of four or five weeks. Hydrocyanic acid, in doses of one-third of a drop to a child of five years, is a valuable remedy in this malady, but should be used with caution, especially for young children, on account of its powerful depressing and poisonous effect in overdoses. A mixture of cochineal and carbonate of potash is highly recommended by some authorities, particularly when violent vomiting accompanies the fits of coughing. Chloral, the inhalation of sulphuric ether, and the inhalation of the nitrite of amyl, have all seemed to be beneficial in whooping cough, but are too dangerous for indiscriminate employment. Quinine, iron, and other tonics are very valuable in combatting the anæmic condition, which is very apt to develop in severe cases of this affection.

### MUMPS OR PAROTIDITIS.

This is an epidemic and contagious disease, affecting the salivary glands, more especially the parotid glands. The contagion is apparently given off with the breath of those suffering from it, the period of incubation is about fourteen days, and the height of the complaint is generally attained on the fourth day. Though sometimes severely painful, it is not often fatal, rarely proceeding to the formation of an abscess. Mumps is more apt to affect boys than girls, and epidemics of the complaint usually occur in spring and autumn, during damp or cold weather. Fever with its usual symptoms of headache, heat of skin, and so forth, precede the local symptoms, but the glands back of and above the angle of the jaw on each side soon swell, occasionally to such an extent in severe cases that chew-



ing becomes impossible. The organs of generation, including the ovaries and mammary glands, are not unfrequently swollen and painful.

*Treatment.*—The treatment consists in rest in bed, gentle saline laxatives and febrifuges to mitigate the fever, and the application of laudanum to the skin over the swollen glands, for the purpose of relieving the pain if it is very severe. The diet ought to be made up of farinaceous and semi-fluid articles, such as corn-starch, arrow-root, or milk-toast, and to allay the thirst small pieces of ice may be allowed. Fruits generally should be withheld.

### INFLUENZA.

This is a suddenly developed and intensely severe cold or catarrh, attended with severe nervous depression and violent cough. It often prevails as an epidemic, and is probably contagious. The period of incubation is only a few hours, and although generally a very unimportant affection as regards danger to life, it has in some epidemics spread widely over communities and proved alarmingly fatal. In a severe attack the ordinary symptoms of cold in the head and cough, are all present in a very aggravated form, but the febrile movement may be so intense that delirium and stupor come on. The symptoms persist for from four to eight days, and may then give place to an exhausting diarrhœa. This specific catarrhal fever is apparently not limited to man, as the so-called epizooty of horses and dogs presents very similar characters. One great danger in children especially is that of capillary bronchitis or pneumonia supervening. The diagnosis is not usually difficult when an epidemic is known to be prevailing, and the course of the disease in a day or two would at any rate dissipate all doubt.

*Treatment.*—The patient should be confined to the house, and if the attack is a severe one to his bed. An anodyne and expectorant cough mixture, containing a teaspoonful of syrup of squills, five or ten drops of wine of ipecacuanha, and one thirty-second of a grain of morphia, may be used with advantage four or five times daily, and if the bowels should be constipated, as they commonly are, a dose of five grains of calomel or blue pill, followed by a saline cathartic, such as a Siedletz powder, will often afford much relief. Emetics are to be avoided, and blood-letting is not well borne.

### GLANDERS.

This is a contagious affection, usually commencing with a specific inflammation of the mucous membranes of the nose and throat, and originating in contagion derived from a glandered horse, ass, or mule. It is a febrile disease of a malignant type, the period of incubation of which is

from two to eight days, and it is fortunately rare in this country. Besides the intense local irritation, and ulceration of the mucous membrane of the nose and throat, high fever, and pains in the joints, like rheumatism, are experienced, and about the twelfth day a remarkable eruption of the glander-pustules appears over the whole body. No specific treatment for this distressing malady has yet been discovered, and therefore little can be done for the sufferer beyond endeavoring to palliate the symptoms as they arise, and administering opium in large doses of two or three grains thrice daily to relieve the pain. This failure of remedies renders the careful avoidance of the cause of disease doubly important, and if it were generally understood throughout the community that any horse, no matter how good and kind in harness he is warranted to be, can give this horribly painful and fatal disease to those who run the risk of implanting the minutest particle of his secretions upon their own mucous membranes, there would probably be much less of the unnecessary fondling and petting of these animals than we often see. For the good of society, every horse which is known to be affected with glanders or farcy, ought to be immediately killed, or at least isolated completely from both human and equine companionship.

#### FARCY.

This malady, considered by some to be a form of the preceding, is equally contagious, but fortunately equally rare with us. It is a specific inflammation of the skin and the lymphatic vessels, caused by contagion derived from a diseased horse or mule. Sometimes it is accompanied by the formation of small, soft tumors under the cutaneous surface, called farcy buds or farcy buttons. The same failure of medical treatment as that lamented in glanders is to be noted, and a similar caution in respect to exposure to its contagion from animals is earnestly insisted upon.

#### GREASE OR EQUINIA MITIS.

This is another but milder malady, produced by contagion conveyed by contact or otherwise with diseased animals, especially horses. It is called grease, because one prominent symptom is an inflammation of the sebaceous or grease-producing glands of the skin. The period of incubation is about four days, and the crisis or height of the complaint is reached in about eight days, when the pustules mature. The affection manifests itself in the sebaceous glands about the heels of horses, and when conveyed to man, as may happen in consequence of handling these parts, produces an eruption resembling the cutaneous disease named ecthyma, with febrile symptoms which are often quite severe. When the scabs resulting from the drying up of the eruption fall off, they are apt to leave permanent scars, somewhat similar to those of small-pox.

Frequent purging with five-grain doses of aloes, combined with ammonia, and moist anodyne applications, to relieve pain, are recommended in this disease.

### MALIGNANT PUSTULE.

This is another contagious disease for which we are indebted to domestic animals, it being generally produced by the contagion of splenic fever or anthrax, derived from cattle or sheep. It is in connection with this disease that Dr. Pasteur's brilliant discoveries in regard to attenuating the virus by checking the luxuriant growth of the bacterium producing it, namely, the *Bacillus anthracis*, were announced in 1881. In man it is generally induced by some of the poisoned blood of a diseased animal finding entrance through some little cut or abrasion of the skin. Hence it is especially met with in butchers and drovers. The specific poison, when once implanted, produces in a few hours a slight redness like that from a mosquito bite, and afterwards a little blister. This is soon succeeded by a spreading hardness of the surrounding tissues, which mortify and turn black. Crops of secondary vesicles appear, the neighboring lymphatic glands become inflamed, the breath grows fetid, and death may take place in from twelve to forty-eight hours, with all the symptoms of profound blood-poisoning. After death, the spleen, liver, and lungs are often found stuffed with myriads of the short, motionless rods which characterize the anthrax bacillus. This fatal malady has already been referred to as being the human representative of the disease called *Joint Murrain* and *Black Quarter* by the English drovers, *Charbon* by the French, and *Milzbrand* by the Germans. An early diagnosis in this complaint is very important, because the chief hope of cure consists in the prompt destruction of the primary vesicle and the tissue immediately surrounding it, before the blood generally is infected by the rapidly growing fungus. Unfortunately, the only clue to the true nature of the dangerous little pimple is the history of infection with the blood of some diseased animal, and this, of course, is not in many instances available. In all cases where reasonable suspicion exists, however, the primary sore should at its very beginning be cauterized either with a red-hot iron or with a strong mineral caustic, such as caustic potash or nitric acid. No internal treatment of any practical value has as yet been discovered, and therefore the most watchful care in avoiding the entrance of the infection is of the highest importance. (See page 178.)

### PHAGEDENA.

This a condition of wounds or ulcers, in which the raw surface becomes covered with a rapidly extending layer of dead and putrefying tissue



called a slough. Its true nature is still a matter of dispute, but it is probably the direct result of the active growth of bacteria, which mechanically interfere with the nutrition of the parts involved. It is attended with general derangement of health and often very profound constitutional disturbance, manifested by great debility, heavily coated tongue, and foul breath. A severe variety of the disease is called sloughing phagedena, and the most intense and extremely fatal form is denominated hospital gangrene. These affections seem to be all associated in their prevalence with impurities of air and water, and with overcrowding, so that the most important portion of the treatment is to remove patients to situations where they will avoid these three great causes of disease. At the same time nutritious food, stimulants, and tonics, especially quinine in large doses of fifteen or twenty grains daily, should be administered, for the purpose of improving the general health. As a local application bromine in strong solution has proved very successful. It is probable that the faithful employment of Professor Lister's invaluable antiseptic method for dressing wounds would entirely do away with the occurrence of phagedena and hospital gangrene in all their varieties.

### ERYSIPELAS OR ST. ANTHONY'S FIRE.

This is a specific, contagious inflammation of the skin, tending to spread over large portions of the cutaneous surface. This complaint has, as a rule, for its starting point some slight wound or abrasion of the skin, although occasionally it seems to arise spontaneously, affecting the head and face in such instances more frequently than any other portion of the body. The specific characteristic of erysipelas, or rose, as it is also called, is the diffuseness of the inflammation of the integument, and the absence of any limiting effusion such as is ordinarily met with. The effusion in this complaint is chiefly of the watery portions of the blood, as in dropsy, and in severe cases this takes place very abundantly, so that enormous swelling of the affected parts may ensue. The lymphatic vessels and glands are almost always more or less affected, and poisoning of the blood as in pyæmia not infrequently occurs. One attack of the disease, so far from affording any protection, generally leaves the patient particularly susceptible to the malady for a long time, perhaps for life. Numerous varieties of the complaint are described. The most important of these are, first, the simple form, in which the inflammation is entirely superficial, and confined to the surface of the skin. If uncomplicated with other diseases, this variety, although very alarming in appearance, is not often fatal, recovery after a week or ten days being the general rule, if proper treatment and nursing are faithfully pursued. The second form is denominated phlegmonous erysipelas, and in it the inflammation penetrates below the under surface of the skin into the cellular or connective tissue. In

this situation it is very apt to result in the formation of boils or phlegmons, which give rise to great suffering. It is a much graver form of the malady, and is at all periods of its course a dangerous and deceitful disease. The third form, called gangrenous erysipelas, is that in which mortification of the erysipelatous parts rapidly comes on, and this modification which may arise out of either of the others, from a bad condition of the system or unhygienic surroundings, is liable to prove quickly fatal.

Although infection by the poison of erysipelas does not often take place outside of hospitals its occurrence in large institutions, where many patients are crowded together, is so certain, and occasionally so rapid, that every precaution ought to be instituted against its spread. Under the present writer's observation, erysipelas has been seen to run along the whole side of a large hospital ward, leaping from bed to bed with marvellous rapidity. In some instances moisture from too frequent washing of the floors, thus causing constant great humidity of the air, has been supposed to aid in its development. In some large hospitals its germs appear to have regularly taken up their abode, and are ready at any time to pounce upon and infect any patient suffering from a wound, or open sore of whatsoever kind. In England an old hospital ship, called the Dreadnaught, became so filled with the poison of erysipelas that she had to be broken up and another vessel substituted. When erysipelas has once developed in a crowded room or hospital ward nothing will avail with certainty to put a stop to its spread, except entirely removing the patients and disinfecting the apartment, very much in the way adopted in the New York cholera epidemic and described on page 360. The patients should be placed in well ventilated tents or huts. In dressing the wounds of erysipelatous patients, great care should be taken to purify all instruments, as for example, by dipping them, when well washed, into a strong, that is a ten per cent., solution of carbolic acid directly after they have been used, also to carry no lint, sponges, bandages, and so forth, from them to other cases, and to destroy, or disinfect immediately, all dressings, clothing, and similar articles soiled with discharges from the sores; making use, therefore, of what Dr. Sanderson calls "surgically pure" apparatus and instruments, that is, instruments purified from living bacterial germs in every instance.

Quite recently a Dr. Fehson claims to have discovered the bacteria of erysipelas, and following the method of Dr. Koch has, after cultivating the organism upon gelatine films for several generations, proved that it is the virulent poison of the disease, by its producing erysipelas when inoculated upon the ears of rabbits.

That terrible malady, puerperal fever, is now generally recognized as being, in some forms at least, the effect of erysipelatous poison, acting upon the uterus after childbirth. This, however, will be more fully discussed in the section on diseases peculiar to women.

*Treatment.*—The treatment of erysipelas comprises rest in bed, saline

laxatives, cooling drinks, and a nutritious yet unstimulating diet. The tincture of chloride of iron, in full doses of twenty or thirty drops in a table-spoonful of sweetened water every two or three hours, has been so successful in the hands of many physicians, that it has come to be regarded almost as a specific. In the phlegmonous, and still more in the gangrenous form, quinine, Peruvian bark, and alcoholic stimulants, are chiefly to be relied upon. The affected parts may be covered with raw cotton, and dusted over with flour or powder of oxide of zinc. In some instances moist applications afford more relief, and a moderately strong solution of lead water and laudanum may be applied on soft linen rags, covered with oiled silk. For erysipelas of the face, when the alcohol in the tincture of opium is objectionable, a favorite prescription of the present writer is a mixture of a tea-spoonful of Goulard's extract and two table-spoonfuls of distilled water, in which a grain of acetate of morphia is dissolved. Ointments and other greasy applications to the inflamed skin of a patient suffering from erysipelas should be avoided. Painting with iodine, nitrate of silver solution, and the application of blisters to sound skin, for the purpose of checking the spread of erysipelas, are now generally abandoned as useless, if not injurious.

#### PYÆMIA OR SUPPURATIVE FEVER.

This is a specific, febrile condition, generally but not always consequent upon the suppuration of wounds in the soft parts, but especially of bones, as in compound fractures, and in the surgical operations of amputation and resection. Sometimes, however, it appears to depend upon boils, carbuncles, and on the conditions of the puerperal state. One of its most important characteristics is the occurrence of secondary, often of multiple abscesses, in the internal, vital organs, such as the lungs, liver, kidneys, spleen and brain, so that its terrible fatality will be at once understood. Occasionally the abscesses form in the glands, the joints, or in the connective tissues, and under such circumstances, although liable to wear out the unfortunate patient's strength, these painful complications are not so certainly fatal. There is now little doubt that pyæmia is really caused by the development of a bacterium, the *Micrococcus septicus*, in the blood, and that the multiple abscesses are produced by masses of the fungoid growth, obstructing the finer blood-vessels, and by cutting off the blood-supply bringing about the local death of small portions of tissue, as for example in the lungs, or the liver, which form the starting-points of suppurations in these different organs. Septicæmia is the name applied to a form of pyæmia, where the blood only is affected, without secondary abscesses being produced. In it the fever is intense, and the constitutional disturbance from the poisoned blood very great. The specific fever of pyæmia generally commences suddenly, with intense and



repeated chills, appearing from the third to the fifth day, after an injury or operation. The disturbance of the nervous system, and the febrile symptoms, are often very similar to those seen in typhoid fever. With each secondary suppuration or metastatic abscess, the chills are apt to be repeated, and they may sometimes be distinguished from the paroxysms of ague by their coming on at night instead of in the daytime. High fever and often profuse sweating occur during the suppurative process. The pus of these abscesses is itself infective, containing a poison which, if it enters the circulation, or is inoculated by any accident upon another person, is capable of reproducing pyæmia.

The diagnosis of this malady is often for a time difficult, but it can generally be made out from the history of the case. The prospect of recovery is very doubtful, as pyæmia is one of the most fatal diseases we have to encounter, and even in the few cases, where temporary improvement takes place, no security can be felt for many, many months, that the deceitful affection is not lurking somewhere in the system of the doomed patient.

*Treatment.*—Quinine in large doses of ten grains, two or three times daily, with tonics, stimulants and nutritious food are the remedies which afford some chance of success; but the most important duty is to prevent pyæmia by faithful and diligent employment of the antiseptic method for all surgical operations and open wounds.

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## CHAPTER VI.

# THE CONSTITUTIONAL DISEASES.

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In this group of the general diseases are comprehended, for the most part, disorders which are apt to invade different portions of the same body simultaneously or in succession. They are sometimes spoken of as the constitutional diseases, and often manifest a tendency to transmission by inheritance. They are distinguished from the first section of the general diseases by this fact of their being subjects of hereditary tendency, by their comparatively long duration, and by their liability to frequent recurrence in the same person.

### ACUTE RHEUMATISM, OR RHEUMATIC FEVER.

This is a specific, febrile disorder attending a diseased state of the system, and characterized by an inflammation of a peculiar and non-suppurative kind, in the fibrous tissues about or surrounding the joints. This inflammation is especially apt to occur in the white, fibrous tissues, such as the sheaths of the muscles, the capsular ligaments of the joints, the bursa or synovial sacs, and the endocardium and pericardium or membranes within and around the heart. A great number of the joints may be affected at the same time, or in succession, and in some severe cases it seems as if every joint in the body is simultaneously swollen and excruciatingly painful on movement. Ordinarily, these local phenomena occur in the joints of one or two limbs only, but they have a curious tendency to shift from part to part, sometimes flying in a few hours from one extremity to another of the frame. The fever is usually accompanied in marked cases by very profuse, acid perspirations, by the elimination of large quantities of uric acid and the urates, in the secretion from the kidneys, and by a great increase in the amount of fibrin in the blood.

The poison of rheumatism does not seem to be introduced from outside the body of the person affected, but to be some injurious material generated inside the system, which has failed to be eliminated during the ordinary processes of the animal economy. It also seems, at least in some instances, as if the poisonous material gradually accumulated in the system, and when it reached a certain amount exploded in an attack of the disease. The injurious agent is believed by some physicians to be lactic acid, but such a view is as yet by no means universally accepted. One of the results of acute or inflammatory rheumatism is to bring on a thickening of the parts affected, and to cause opposing surfaces, such as those of the membrane enclosing the heart, to adhere to each other. Strangely enough, however, the inflammation of rheumatism, even in its most violent form, rarely goes on to suppuration. Although rheumatism is able to affect so many different parts of the system, the joints are the ones to suffer most in nine-tenths of the cases. With them, however, the valves of the heart are very apt to be somewhat affected, and this disturbance of these most important little structures is liable to continue in a subacute or chronic form, ultimately interfering so seriously with the due performance of their function as to make life miserable, and the fatal issue which they hasten a welcome relief from pain. The valves of the heart may become affected by the rheumatic poison, apparently without an acute outbreak of rheumatic fever, and this crippling of the valves may in turn bring on Bright's disease of the kidneys, with all its attendant evils and fatal result. During acute rheumatism the patient is liable to pulmonary disease, apparently of a rheumatic origin, and bronchitis, pneumonia and pleurisy may unite to overwhelm the subject.



*The Muscular System, Back View*





The local symptoms of inflammatory rheumatism are usually preceded by fever, with its headache, hot skin, and feelings of uneasiness and discomfort. The patient during this forming stage as it may be called, as well as later in the attack, is particularly susceptible to changes in the weather. His face is generally pale and sallow, his eyes dull, and the whites show a yellowish tint. Contrary to what is noticed in most other febrile diseases, the skin of a rheumatic patient may be very hot and yet bathed in profuse and sour-smelling perspiration, and it is often observed that the pain in the joints is more intense if this sweating does not occur. The renal secretion is scanty, of high specific gravity, deeply colored, and deposits a dark red or brownish sediment of uric acid and its compounds. There is great thirst and, as a rule, the bowels are constipated, partly, perhaps, because the patient strives to restrain their evacuation, on account of the intense pain which the slightest movement causes him. The fever usually continues high for ten or fourteen days, unless cut short by treatment, and the average duration of the disease is from four to five or even six weeks. Still, sometimes mild cases are only sick ten or twelve days altogether, and when the remedies described below prove successful, the acute symptoms may often be relieved in a much shorter time even in severe cases.

The diagnosis of inflammatory rheumatism must sometimes be made from relapsing fever, and occasionally from the other eruptive fevers, from pyæmia, from gout, from synovitis, and from trichiniasis. The pains in relapsing fever are often described as rheumatic, but there is generally no swelling of the joints, and the fact of an epidemic of relapsing fever prevailing serves to prevent error. The distinction between inflammation of the joints, such as occurs from injury or in the course of pyæmia, is sometimes difficult at first, but here the history of accident and the want of the acid perspirations of rheumatism will soon clear up the diagnosis, even if the shifting character of the rheumatic affection does not earlier disclose the true nature of the attack. The family history may also throw important light upon the problem, as was pointed out when speaking of hereditary tendency on page 46.

*Treatment.*—In the treatment of rheumatism, until within the past few years, the main reliance was upon purgatives, opium to relieve pain, and alkalis, especially the carbonate of potash, to neutralize the supposed acidity of the blood. Within the last eight years, however, the use of salicylic acid and its salts, particularly the salicylate of soda, in doses of five grains every two, three or four hours, has gradually become common, and in some cases the attack can be cut short in this way within twenty-four or forty-eight hours. Many physicians prefer, however, to give the acid compound in smaller doses, checking the pain and fever, in favorable cases, at the end of two or three days. Notwithstanding the frequent success of this treatment, in some instances it produces a beneficial effect

very slowly, and in others appears to fail entirely, so that its exact value as a remedy in rheumatism is not yet fully determined, and certain physicians still entertain much doubt whether it is a complete specific for the disease, as it was at first hoped would prove to be the case. In regard to the local treatment of rheumatism, the ancient prejudice against any cold applications to the inflamed joints, for fear of driving the malady to some vital organ, has very much diminished, and practical experience with the cold pack has proved its harmlessness. Much relief may be afforded by wrapping the affected joints in raw cotton-batting, covered with oiled silk, which promotes the formation of a local vapor bath when perspiration is copious. Applications of lead-water and laudanum often mitigate the pain in the smaller joints, and occasionally dipping an inflamed hand and wrist in a pitcher of very hot water, the temperature of which is as high as can be borne, will for a time completely assuage the suffering. After the acute stage has passed, if pain and swelling still linger in the affected limbs, counter-irritation by painting with iodine, or by the application of small fly-blisters, is frequently of great service.

If the temperature of the patient, as tested from time to time by the thermometer, rises above  $104^{\circ}$  or  $105^{\circ}$  F., efforts should be made to reduce it for the sake of avoiding the dangerous influence of the overheated blood upon the nerve-centres. This may be accomplished, as suggested in typhoid fever, by the administration of large doses of quinine, of salicylic acid, or by the cool bath or cold sponging. Whatever risk may be run, if there be any such encountered, of driving the disease to the heart, stomach or brain, as was formerly feared, is generally a lesser evil than the danger to the animal economy from prolonged, excessive blood-heat.

The treatment of inflammation of the membrane lining the cavities and valves of the heart, called endocarditis, and of the membrane surrounding the heart, denominated pericarditis, when they occur during the course of rheumatism, will be considered in the article upon cardiac diseases.

*The Nursing and Diet* required in acute and subacute rheumatism are very similar to those demanded in the eruptive fevers, except that the utter helplessness of the patient renders necessary an even more constant vigilance, so that the nurse may always be on the alert to anticipate every wish as far as possible; and the excessive irritability of the sufferer, which we must look upon, often, as an essential part of the disease, should be allowed to impose a mighty tax upon the patience and forbearing kindness of the attendant, without ever exhausting his wealth of these great, Christian virtues.

Since a single attack of rheumatism generally indicates a predisposition to the disease, and it is not common for any one to escape without at least one recurrence of the disorder, it is exceedingly important for an individual affected with the rheumatic tendency to avoid exposure to



cold and wet, which often seem to act as exciting causes. The unfavorable influence of these agents may have been over-estimated, as is claimed by certain high authorities, but experience in the treatment of old sailors whose exposure to vicissitudes of the weather is unusually great, and who generally complain very much of rheumatism, tends to indicate that these two morbid agents are frequently contributing if not primary exciting causes of the malady.

### CHRONIC RHEUMATISM.

In some instances this form of the disease in question remains after an attack of the acute variety, like a legacy left to the sufferer, after its departure from the scene of action. At other times the affection appears to arise without any preliminary acute inflammation. The larger joints, comprising the elbow, shoulder, ankle, knee and hip, are the ones most apt to be affected. Commencing generally at the bases of the capsular ligaments, or fibrous sheaths which surround the joints, this low form of inflammatory action is apt to extend to the periosteum or membrane ensheathing the bones, and induce there and in the interior of the joints such a chronic alteration as in some cases leads to the complete removal of the synovial membrane and articular cartilages. In place of them appears, in some instances, a hard, unyielding, porcelain-like substance, having, it is true, a polished surface, but without any of the elasticity of cartilage, and of course devoid of secreting power, because destitute of synovial structure. This type of rheumatism is especially prone to attack those joints or places in the shafts of the long bones which have been the seats of dislocation, contusion or bruising, fracture, and indeed of any severe injury. Prolonged and repeated attacks of chronic rheumatism are liable to produce great deformity of the parts affected, as for example in the hip, as is frequently observed. These are much more common in later life, and seldom met with before the age of thirty years. The symptoms of chronic rheumatism are almost always aggravated at night, and by vicissitudes of the weather, especially the prevalence of east winds or moist and cold states of the atmosphere, and they are apt to be associated with derangement of the digestive organs. This form of the complaint is especially common among the laboring poor, and in soldiers and sailors, as they become advanced in life, after a long, hard battle with the opposing forces of weather and season. The pain on motion in the affected parts is generally greatest after resting for some time, and therefore especially in the morning subsequent to the repose of the night. After exercising for a while, the suffering in the stiffened joints may almost or quite disappear, to recur unfortunately after another period of inaction.

*Treatment.*—The prospects of cure in chronic rheumatism are not good, and the best which can be said of the complaint is that it has no tendency

to produce a fatal result. And yet remedial measures are not wholly without effect upon this almost hopeless malady. The medicines which are most likely to prove beneficial are tea-spoonful doses of the tincture of guaiacum, iodide of potassium in five-grain doses, mercury in very minute quantities of one-sixteenth of a grain, and occasionally colchicum. The efficacy of sea-bathing is very marked in some instances, and baths in warm springs, and especially warm, sulphur springs, have often been productive of benefit. (See the chapter on Baths and Bathing, and especially page 105.) Local frictions with anodyne and stimulating liniments, such as a mixture of six fluid-drams of laudanum, four of chloroform, two ounces and a half of liquid opodeldoc, and two fluid-drams of oil of red thyme, are not to be despised as remedial measures, but it is necessary that they should be employed long and perseveringly. Repeated, small blisters of the size of a silver half-dollar, applied every week for three months, or a milder counter-irritation by liberal painting with tincture of iodine, are valuable in some cases. Electricity has also had some earnest advocates as a curative agent in chronic rheumatism, when serious disorganization of the tissues has not yet taken place.

### MUSCULAR RHEUMATISM.

Of the minor painful maladies, it is probable that this disease is the most common in many parts of the country, and the vast number of nostrums offered for its cure attest the widespread anxiety to get rid of its uncomfortable companionship. Among the varieties frequently met with may be enumerated lumbago, which affects the sheaths of the large muscles of the back and loins, sometimes extending to the ligaments of the sacrum. The pain is severe and generally of very sudden occurrence, so that the patient often imagines that he has strained his back, perhaps without being able to specify when the accident took place.

Stiff neck, or cervical rheumatism generally follows exposure to a current of cold air striking the shoulder and neck, and affects the large muscle attached to the side of the head behind the ear, and, at its other extremity, to the breast-bone and the collar-bone. The business of this muscle is, by contracting, to turn the face to the opposite side, and when affected with rheumatism, in order to put it on the stretch as little as possible, the patient rotates his head toward the affected side instinctively, and retains it in that ridiculous position because it causes so much suffering to hold it in the usual way.

Pleurodynia or pain in the side usually arises from a similar rheumatic affection of the muscles concerned in breathing, especially the short, flat muscles between the ribs, named the intercostal muscles. It is hence called also intercostal rheumatism, and as the pain thus produced very closely resembles that of pleurisy, it often gives rise to much needless

alarm for fear that the more serious disease is present. In many instances the only way to be sure in regard to this matter is to make a thorough examination of the lungs with a stethoscope, and determine their healthful condition; but as a general rule the absence of pleurisy may be at least strongly suspected if there is no cough, no fever on testing with the thermometer, and if the muscle on the affected side is very sore to the touch or on pressure.

*Treatment.*—The treatment of pleurodynia consists in putting the rheumatic muscles at rest, as far as possible, which, however, can only partially be accomplished, because, being concerned in the vital process of respiration, they must continue to do some share of the duty. The best way to accomplish this object is to apply strips of adhesive plaster, overlapping each other, around the affected side so as to compress that half of the chest as tightly as possible. The same thing may be secured, though less perfectly, by careful application of one of the ordinary porous plasters so much in vogue, and these are also useful in lumbago and in stiff neck. Fifteen drops of wine of colchicum, with a quarter of a grain of opium, using these in small, but frequently repeated, doses, is often beneficial in these forms of rheumatism, and if the suffering is intense, a hypodermic injection of a quarter of a grain of morphia will afford very prompt relief, but must be employed with great caution.

#### GOUT OR PODAGRA.

Acute gout is a specific, febrile disorder, characterized by inflammation without suppuration, by considerable redness of certain joints, chiefly those of the hands and feet, and, especially in the primary attack, of one of the great toes, and attended with an excess of uric acid in the blood. When gout has fully developed it is liable to cause all the forms of inflammation of the joints, and of those other portions of the body which have been described as the seats of acute rheumatism. These manifestations have little to distinguish them from those of rheumatism, except the curious tendency which exists to deposit in the inflamed tissues the hard, white, chalky substance, called urate of soda. Uric acid, which is the remarkable ingredient in this chalk-like compound, is found in the serum of the blood during the attacks, and it seems to have a tendency to accumulate in the system until, after a longer or shorter interval, such a store of it is formed that it produces a paroxysm or fit of the gout, when various joints or other structures of the body may become affected. Whilst this paroxysm can apparently, when the accumulation of uric acid is very large, come on without any particular exciting cause, it very frequently happens that some exposure to cold, or some imprudence in diet, seems to determine its onset. Gouty patients will occasionally admit that they could feel each glass of champagne as they drank it, tingled along the



limb until it reached the gouty toe, and there waked up the twinges of their old enemy.

It is now generally believed that gout is hereditary, and in many instances it is so, whether the habits of intemperate ancestors be followed out, or whether the living be abstemious. In some families it attacks only alternate generations, according to the law of Atavism as explained on page 43. Where the hereditary predisposition or diathesis, for a description of which see page 51, is present, there is no doubt as to the powerful effect of full living, with the free and habitual use of wine, as an exciting cause. Especially is what is called gross living, that is, a great and indiscriminate consumption of animal and vegetable food, with indulgence in beer and malt liquors, hurtful. It appears that it is not so much the particular variety of alcoholic drink employed, as the mode and extent of its use, which determines the development of the gouty condition. It is believed, however, that of all the wines in common use among civilized nations, those of the Rhine vintages are the least productive of gout. This is probably because they contain less alcohol than those of Italy, the south of France, Spain, and Portugal.

The influence of malt liquors is especially obvious in the examples of gout which occur in the lower classes, who drink much beer and take little food. It is interesting to remark that in those countries, as for instance Scotland, where beer is not drunk as a stimulant, the lower classes usually escape the gout.

In a general way it may be stated in the first place, that hereditary tendency is the most important factor in causing gout, as it can be traced to this source in about one-half the cases. Secondly, the supply of more nourishment, especially the nitrogenous elements of food, than is used or required by the system to replace what has been worn out by proper labor or exercise, is another very important factor in the development of this painful disease.

A fit of the gout comes on usually after several days of discomfort about the digestive apparatus, perhaps suddenly in the night. The pain at first is only moderate, and feels as if the bone of the great toe had been dislocated. It grows more violent, however, every hour, and towards morning becomes agonizing, being compared by Dr. Sydenham, who was himself a great sufferer from this complaint, sometimes to the laceration of the ligaments of the foot, sometimes to the gnawing of the foot by a dog, and sometimes to a heavy weight pressing and contracting the affected parts. With such an attack of pain there is considerable fever, and when the suffering remits, as it frequently does in about twenty-four hours, marked swelling of the part involved is found to have taken place. After a day or two the pain usually returns, and an ordinary fit of the gout is made up of several of these smaller fits. In favorable cases complete recovery from that particular paroxysm may eventuate in a week or two, but in

those who are debilitated, either from age or from a long duration of the gout, it may last two, three, or more months. In severe attacks both feet, both hands, wrists, elbows, and knees, may be involved, and the final result, in the fingers especially, has often been to render them distorted or even almost immovable and quite useless. The functions of digestion, and especially those of the liver and the kidneys, are very much disturbed in a fit of the gout, and loss of appetite, heartburn, flatulence, colicky pains, and constipation are the usual consequence. Gout frequently becomes chronic, and cripples the patient wholly or partially, and the same may be said of rheumatic gout, which, although more often seen, is, happily, still comparatively rare in America.

*Treatment.*—The medical treatment of gout is by no means satisfactory, and whilst much can be done towards relieving the sufferer by the use of opium, for example, in the form of ten grains of Dover's powder internally, or the eighth or quarter of a grain of morphia by hypodermic injection, a permanent cure is but seldom accomplished by medicines, unless hygienic precautions against a renewal of the malady are faithfully pursued. For the relief of a fit of gout, saline purgatives, such as epsom salts, Glauber's salts, or the citrate of magnesia, mercurials such as six or eight grains of blue pill, or calomel, combined with as much jalap, and colchicum, either in the form of tincture, of which the dose is from ten to twenty drops, or of wine or extract, are very useful. As local applications to the affected parts, warm anodyne fomentations or lotions, the lead-water and laudanum mixture already recommended in rheumatism, and a warm mixture of spirits of camphor and milk, give some relief from the intensity of the pain. The extract of witch hazel has also been used with success.

After recovery from the paroxysm, however, if the patient wishes to escape further attacks, his habits in regard to diet and exercise must be regulated with the greatest care. Vegetables with soups and meat must be partaken of but once a day, not oftener. Beer, wine, and all other alcoholic liquids must be absolutely forbidden, and tea and coffee had better be abstained from also. Pure water should be the only beverage, and be swallowed in as large quantities as the stomach will conveniently bear, since it increases the flow of the secretion of the kidneys, and promotes the elimination of urea, which, if not properly formed and excreted, probably has its elements converted into the uric acid, which produces the symptoms of gout. Associated with abundant muscular exertion, the use of pure water hastens, to the greatest possible extent, the transformation of tissue, and united with the employment of certain mineral waters and baths, a connecting link is thereby established between the dietetic and the medicinal treatment of gout. When the patient is robust and of full habit, and a tendency to constipation is present, the purgative mineral waters, such as those of Saratoga, are called for. Where the skin is inac-

tive, and a rheumatic element is mingled with the gouty diathesis, sulphur waters, such as those of Sharon and the Virginia White Sulphur Springs, should be resorted to. And where there is much debility, simple thermal and chalybeate mineral waters ought to be employed.

### CANCER OR MALIGNANT DISEASE.

Cancer is defined to be a deposit or growth which tends to spread indefinitely into the surrounding structures and along the course of the lymphatics leading from the part of the body affected, and to reproduce itself, whether removed by operation or not, in remote parts of the system. Although we are still totally ignorant of the primary cause of cancer, it is inferred from various considerations that in the development of this terrible disease a peculiar, morbid material is separated from the blood, as in other constitutional maladies, and is constantly being renewed in the formation of the cancerous structure. There are no germs in the blood previously to the development of a cancer-tumor, which can be recognized by their structural characteristics, but it is evident that a specific diseased state of the system exists in the constitutional ill-health, or taint, associated with cancer from the following circumstances; first, because all parts of the body are liable to be infiltrated with the peculiar and specific growths, which constitute the cancers or malignant tumors, and that without any direct communication with the spot where the first development took place; second, because the removal of the locally diseased part does not commonly arrest the progress of the constitutional disease; third, because the cancer growths tend naturally to the destruction of life, independently of their location, through a peculiar deficiency of vital force, or cachexia, which their presence establishes in the organism, and which some pathologists believe is due to the exacting demands which these new growths make upon the system for contributions to their nutrition and increase. But these growths also act locally by tending to the destruction of the tissues around them. A continual hectic fever is established, and increasing emaciation follows the intense bodily suffering and mental anxiety produced. The countenance becomes pale, distressed, and assumes a slight leaden hue, the features grow pinched, and the lips and nostrils somewhat livid. Towards the last there is generally nausea or frequent vomiting, with greatly impaired digestion, and a troublesome cough comes on. Darting pains of agonizing severity shoot through the cancerous growths, the pulse becomes rapid and faltering or irregular, the breathing hurried and oppressed, the surface cadaverous, and death alone brings relief.

Cancerous disease is very prone to pass by inheritance, in a form peculiar to itself, from parent to offspring and to occur, probably by this transmission of common tendencies, in many members of the same family



and generation. At least one in every three persons affected with cancer, according to Sir James Paget's experience, traces this descent from families wherein the occurrence of cancer is well known. The general disease is thus either inherent by birth, or in some other way innate, from the beginning of separate existence. Its presence and complete development are indicated by the occurrence of the peculiar growths in question, in different parts of the body, to which the names of cancers or malignant tumors are applied.

In brief, the malignant character of these growths is indicated by one or more of the following peculiarities: Constant progress of the tumors, their continuing to return after complete removal, not only in the original seat, but in distant and internal parts of the body, destroying and causing the absorption of the invaded structures, infiltrating themselves into the tissues to an indefinite extent, tending to soften and ulcerate, and to affect the glands, to which the lymphatics lead from the seat of the local disease. The increase and nutrition of these new growths produce a peculiar cachexia or depraved state of the entire system, which tends to terminate in death. The anatomical structure of the new growths is, as a rule, different from that of the portions invaded.

Women appear to be more liable to suffer from cancer than men, and this preponderance in the female sex is chiefly due to cancers of the breast and the uterus. In man it is more especially the skin, the digestive organs, and the bones, which are involved. According to the annual reports of death, the mortality from cancer goes on increasing for every ten years until the eightieth year. It is, therefore, evidently a disease of degeneracy, the frequency of which steadily increases as old age comes on. In fact, it has often seemed to the present writer, that cancer was merely a mode of growing old locally—a premature death of part of the body only, instead of an early dissolution of the entire organism, save as an accident resulting from the giving way of one of its essential portions.

Age has also much to do with determining the form of cancer, and the parts affected. Hard cancers are rarely observed until after forty, and from that period the liability increases with age. Their most usual seats are portions of the frame in which age and functional activity have left their marks. Thus they seldom occur in the female breasts, the uterus, or the ovaries, until after the period of the change of life, and in men the reproductive organs are not apt to be affected with hard cancer until advanced life is attained. Nor are hard cancers generally seen in the various portions of the alimentary canal until after the age of forty years, about which time, if we may judge from the changes which occur in the teeth and hair soon after this epoch, degenerative changes commence in various parts of the frame. Soft cancers are more common in the earlier periods of life, but then they are observed to involve textures, the functional activity of which has been great almost from infancy, such as the

glandular apparatus, for example, the lymphatic and the lachrymal glands.

The local exudations which constitute malignant tumors or cancers are made up,—first, of a material peculiar to cancer, consisting, as is seen by microscopic examination, of very varied forms of nucleated cells, nuclei, and fluid “juice,” distributed through an intercellular substance;—second, of connective or areolar tissue, which constitutes the stroma or skeleton part of the new growth. These cancer cells when highly magnified resemble the nucleated epithelial cells of the epidermis, as shown in Fig. 4, and the connective tissue, or stroma, is very much like the fibrous tissue of the true skin, depicted at *a* in Fig. 5. The cell structures are the essential part of the cancer, as a general rule. The relative quantity of these structural elements gives the most reliable and obvious ground, that of consistence, on which the malignant tumors have been classified, namely into hard and soft cancers, but the limits of these classes are by no means fixed by universal consent among physicians. It is usually agreed, however, that when the fibrous structure or stroma is predominant, the growth may be pronounced a hard cancer, and it is generally designated as a scirrhus. When, however, the cellular elements are found on microscopic examination to be more abundant, that is occupy more bulk than the stroma, the tumor is called soft, and is commonly spoken of as an encephaloid or brain-like, or a medullary or marrow-like cancer. Sometimes the supposed nature of the cancerous substance has been used as a basis of classification.

The primary cancer growth commences in the textures of certain organs rather than of others; for instance, the first appearance of a cancer may be in the breast, the uterus, or the stomach. Secondary cancers, or those which, after some months perhaps, follow the original malignant tumor, apparently as a result of infection from that primary growth, are most frequently developed in the lungs, the liver, spleen, and lymphatic glands. We have no positive knowledge why certain organs should be the seats of primary cancer. Before the age of thirty, the eye and associated parts are most apt to suffer. Between the ages of thirty and fifty, the reproductive organs in both males and females are most liable to be affected, and after fifty the digestive apparatus and the skin become the favorite seats of cancerous disease.

SCIRRHUS or HARD CANCER has two stages, the first that of hardness, and the second that of softening by commencing decay. It is especially characterized by the solidity of the primary tumor, and by a disposition to draw to itself the neighboring soft structures. It tends to ulcerate, finally, and the resulting sore is commonly deep, uneven, and bounded by a thick, everted edge. The name of cancer, which is the Latin word for a crab, was originally applied to malignant scirrhus tumors, on account of the fancied resemblance of scirrhus of the female breast with its radiat-



ing lines of secondary cancerous growth, extending in various directions along the lymphatics, to that creature. These cancerous extensions along the lymphatics are often spoken of in popular language as the *roots* of the cancer, but on account of the general poisoning of the system above referred to, no such security is afforded by extracting a cancer with those prolongations attached against a return of the malady, as would be afforded to a gardener by pulling up a noxious weed "by the roots." The single hard, scirrhus lump constitutes the first stage, and from this it may either grow in masses or may be infiltrated, as if poured, whilst melted, into the tissues of the part or organ affected, this latter being the more common form. When in masses these are generally lobulated like some kinds of tomatoes, but dense and firm, often enclosed by a well-defined membrane or cyst wall. Such masses, when examined after removal by operation, are usually found to be made up of two substances, one, the true cancerous growth, and the other, the natural connective or fibrous tissue of the part involved. Hence the appearance of the cut surface in general is that of a hard white semi-cartilaginous material, streaked by fibres, which seem to radiate to the circumference of each nodule, from their respective centres of primary growth. These nodules are commonly of considerable density and firmness, but may vary from that of hard-boiled egg to the consistence of gristle or cartilage, through which when cut the knife makes a grating noise as it passes. The specific gravity or relative weight of these scirrhus tumors is very great, and so marked that, in portions when it can be conveniently estimated, as for example, the female breast, it is considered by some distinguished surgeons as an important aid in diagnosis. In regard to the microscopical appearance of the cellular elements in cancer, about which there have been such endless discussions, the great characteristic is variability in size and shape, from which alone a correct opinion in respect to the malignancy of a growth can sometimes be expressed. After a certain indefinite period, which varies in different cases from a few months to a few years, the scirrhus stage of hard cancer terminates, and the second stage, that of softening, commences. In hard cancers of the mucous membranes this softening usually takes place upon the surface, or superficially, as for example, at the mucous surface of the neck of the uterus, or of the stomach. An ulcer is speedily the consequence of this softening process, and it may be at first quite shallow, presenting many remarkable varieties, such as inverted or everted edges, and an irregular form, whilst the bottom of the sore may be healing up at one part, and sloughing or dying out at another. More or less rapidly it burrows down beneath the tissues, often excavating its way between the cancerous lobules, and it may ultimately penetrate a serous membrane, such as the pleura, which happens to lie in its path. The discharge from a cancerous sore of this kind is of a very fetid character, often disgustingly so, and may render the room, or even the whole house, insupportable



without the use of disinfectants. The liquid which comes away is not the usual healthy matter or pus, but frequently a thin, watery or bloody fluid, to which the name ichor has been applied. Often it is of a very acrid nature, so much so as to inflame the neighboring parts over which it flows. In a small percentage of cases, some large blood-vessel in the substance of the cancer ulcerates, and the patient dies rapidly, or suddenly, if an artery of great importance is involved, from hemorrhage.

The duration of the scirrhus or hard stage of a cancerous tumor is very uncertain, for, whilst it may terminate in a few months or a year, as is perhaps more frequently the case, it may last for several years. A cancerous mammary gland, for instance, has been known to remain indolent for fourteen years, and then be removed by operation without ever having caused much suffering. This indolent or inactive state of cancer is limited to the hard stage, for, after it has commenced to soften, its course is usually rapid, and a few months, possibly a few weeks, may terminate the patient's life, the affected part in true cancer seldom if ever cicatrizing or healing over and being restored to a healthy condition.

MEDULLARY or soft cancer affects especially the solid internal organs, such as the liver, for example. It is characterized by a smoothly-lobed surface, soft, irregular consistence, richness in blood-vessels, and usually rapid growth, and reproduction if removed by any operation. When it commences to ulcerate, portions of the cancerous lobules are very apt to protrude in large, irregular masses, which are so full of blood-vessels that they bleed copiously, often on the slightest touch. This particular form of soft cancer has received the name of *Fungus hæmatodes*, or bleeding fungous tumor. The production of cells in soft cancer is most abundant, and its course is much shorter than hard cancer, the disease generally proving fatal in a few months. Whilst hard cancer, for the most part, affects people in the decline of life, soft cancer is most common in the period from twenty-five to forty years of age. Although medullary cancer is apt to be found in masses, it may occasionally be infiltrated into the tissues which it involves. In whatever form it grows, however, it has, like hard cancer, two stages of development—one of comparative induration or hardness, and the other of softening. The new formation in the first of these conditions may be of varying states of consistence, from that of lard to almost the density of cartilage, though the latter form is rare. When lobules which are not very vascular are cut into, they are often found to be of a bluish, semi-transparent whiteness. The duration of this harder stage is usually from a few weeks to two or three months only, and it is not common for life to be prolonged in a case of soft cancer more than a year at the furthest. Hard encephaloid is a term sometimes applied to cancers of this kind, in which, whilst the cellular elements predominate, the density is greater than the average of medullary cancers.

After this first stage of development is passed, softening commences. This becomes very evident on cutting into the tumor, and scraping the divided surface with the knife, which easily presses out a milky-white fluid called the cancer juice. This whitish liquid is made up largely of the easily loosened cells of the growth, and is considered to have a good deal of importance in the diagnosis of true cancer. As the disease progresses, the entire substance of the new formation is gradually changed in consistence until it approaches that of the brain in density, or even assumes in some cases the semi-solidity of thickened cream. In this stage it varies in color from yellowish-white to red, or even black, from the deposit of pigment. These variations of color are chiefly due to differences in the amount of blood in the tumor, or its admixture with a deposit of melanotic or black cancer. The process of softening may commence at any part of the medullary cancer, sometimes in its centre, at others near the circumference, and after a communication with the exterior of the body is established the quantity of discharge is often very great, and may amount to a quarter of a pint daily. This profuseness of the discharge is owing to the great vascularity of the growth, since the blood-vessels carry a great quantity of fluid material into its interior. The period of softening, naturally brief, as already stated, may be much accelerated by anything which irritates the affected portion. Moreover, if the malignant tumor is removed by operation, the cancerous matter, although in the primary tumor it may have remained for some time in the hardened state, generally develops in its new site without any previous hard stage, and in a softened condition. Soft cancers have been found in almost every organ and tissue of the body. According to some pathologists, the following is the usual order of frequency with which they occur: Most often in the liver, then the mesentery, lymphatic glands, brain, nerves, spleen, organs of reproduction, the eye, the bones, the heart, and lastly the blood-vessels. One of the remarkable features of this variety, and that which usually aids very much in distinguishing it from the scirrhus cancers, is that it is apt to appear in many organs and tissues of the body at the same time, in the same patient. Thus it has been met with in the coats of the bladder, in the liver, and in the lungs, of the same individual. The tendency to reproduction is greater in this than in any other form of cancer, as proved by the very brief period which often elapses before such recurrence after an operation. This reproduction of the malignant tumor may take place either in the edge of the scar left by the wound of operation, or in some organ or tissue quite distant from the original seat of the malady.

EPITHELIAL CANCER, CANCROID, and EPITHELIOMA, are the names applied to cancer, characterized by its occurrence chiefly in parts naturally supplied with an epithelium, and by the resemblance of its cells to those of the epithelium from which it develops. It occurs almost exclu-

sively upon the skin and the mucous membranes, being frequently seen upon the lips and cheeks. The principal sites are in the vicinity of great orifices of the body, but the lips, and particularly the lower lip, are most liable to the development of epithelial cancer. The malignant tumor usually commences as a small, hardened spot, adherent to the skin, and freely movable with it. After a time a pustule, or slight abraded surface forms upon this, and then the deeper parts participate in the growth, which may be mulberry shaped, cauliflower-like, or nodulated. The surface is apt to become ulcerated at a very early period, sometimes when the entire growth is not more than half or three-quarters of an inch in diameter, and thus the centre may soon become excavated by the rapid process of decay in the oldest portions. The resulting open sore has an irregular grey, or perhaps a bloody base, or it becomes covered with crusts, from beneath the edges of which a foetid and ichorous discharge may be caused to exude on pressure. Epithelial cancer tends, after a time, to infect the neighboring lymphatic glands, and the fatal termination is generally by exhaustion, or putrid infection, when the local ulcerative process is not arrested by a surgical operation. In that case, however, secondary cancer is apt to appear in the nearest lymphatic glands, or perhaps in some internal organ, such as the liver or lungs, and prove fatal, probably more quickly, although it may be with less acute suffering, than if it had not been interfered with by the surgeon's knife. The average duration of epithelial cancer is stated to be about six and a half years, but the diversities are considerable, the mean duration of those in the lower lip being three and a half years, and of those of the side of the face being over nine years. The cells and their arrangement in epithelial cancer are generally characteristic when properly examined microscopically, and the best method of determining in many instances whether a suspicious little tumor is dangerous or not, is to have the physician slice off a tiny fragment of the growth, as can be done almost without pain by freezing it, and submit it to a microscopical investigation.

MELANOTIC CANCER or MELANOSIS is a cancer characterized by the presence in its substance of pigment, generally of a black color. Although many of the internal cancers have dark spots and streaks in their substance, true melanosis is quite rare. It may occur in almost every organ, and in fact is remarkable for being thus generally distributed in every part. The cell elements of melanotic tumors are similar to those found in other cancers, except that they contain pigment granules, which, when few in number, may give the structure a yellow tint, but, if very numerous, render it brown or black. This pigment, which is in very minute granules or molecules, is probably derived from the red blood-corpuscles, which appear to be the sources of all the coloring matter of the body.

OSTEOID CANCER is defined as a malignant tumor, usually commencing in the bones, consisting almost entirely of bone, and followed by similar growths in the glands and viscera.



**VILLOUS CANCER** is the name given to cancer in a mucous membrane when covered with a villous or velvet-like growth.

*Treatment.*—It is deeply to be lamented that the hope so long indulged in by physicians, that some remedy for the constitutional state associated with cancer is still unrealized. Hence the treatment of this terrible disease is limited to the relief of symptoms, and the adoption of such palliative measures as will prolong life. Opium, and especially the hypodermic injection of one-sixth of a grain of sulphate of morphia, combined with atropia, one one-hundredth of a grain, is therefore our chief reliance, but it should be used as sparingly as possible, not only on account of the derangements it produces in the digestive apparatus, but also for fear that its effect will be worn out in the system, before death comes to take away the necessity for some means of mitigating pain. Occasionally fifteen grains of chloral, half a grain of codeia, extract of hyoscyamus, and conium, or bromide of potassium in thirty-grain doses, may answer to alternate with the opiates in such a way as to materially postpone the formation of the opium habit in these distressing cases.

In regard to the removal of cancer by a surgical operation, it must be admitted that the prospect of permanent cure by such a procedure is very small, and that the more accurate observations of recent years tend to show that the instances in which removal of a supposed cancerous growth was followed by complete recovery, were cases of non-recurrent, or, as it is also called, benignant tumor, and therefore really examples, not of cure, but of errors in diagnosis. Not only is it argued that we might as well expect to cure rheumatism by amputating the thigh, whilst the malady was affecting the knee-joint, as hope to cure cancer by a similar process, but it truly seems irrational to suppose that a predisposition, which was strong enough after fifty years of struggle with the powers of life, in an individual's system to develop a first cancer, should not, after sixty years of effort against the now weakening organism, be still more likely to succeed in a second attempt. Nay, more than this, as Dr. Walshe long ago contended, excision of a cancerous tumor seems frequently to *awaken* a dormant force, and secondary cancers spring up in all directions, and enlarge with a power of vegetation almost incredible.

In the present state of our knowledge, it appears probable that the wisest plan generally is to have any suspicious tumor removed by the surgeon's knife whilst it is very small, and thoroughly investigated by microscopical examination. If happily found to be benignant, that is innocent in its nature, no further trouble need be anticipated. Should it present the microscopical characters of slight malignancy, it is advisable to repeat the operation in the event of recurrence taking place, as there have been numerous instances where the tendency to tumor formation was apparently thus overcome. If, however, the primary growth prove under the microscope to be of a strongly malignant type, no further surgical interference ought to be allowed under ordinary circum-

stances, and the palliative treatment, as suggested above, is all we have to rely upon. The course suggested above is recommended with a full consideration of the fact mentioned, that such removal of a primary growth may light up a greater activity in the secondary and internal cancerous formation, for the following reasons: First, that whilst such increased rapidity of secondary cancerous development may somewhat shorten life, its injury in this respect is, in most instances, more than counterbalanced by the benefit it confers in diminishing pain, since the suffering of death from internal cancer is usually less than that from the external forms. Second, unless this rule of early removal of all tumors is adopted, many benignant and mildly malignant growths will be allowed to go on developing, both injuring the system and torturing the patient's mind with an agony of suspense, which may be totally needless.

Since, in a large proportion of cases, patients attribute the origin of cancer to some mechanical injury, it is best for those who inherit any predisposition to malignant disease to exercise especial care against receiving any blow or bruise, which might be the starting point of the malady. This kind of vigilance ought to be particularly constant in regard to the female breast, which after the age of forty years is peculiarly subject to cancerous growth.

The management of the tumor when first observed is by no means unimportant, and all picking and scratching at suspicious little lumps upon the face, and particularly about the mouth, the eyes, and sides of the nose, ought to be avoided. Nor should any irritating or caustic application be made to such places, without being approved by the best medical advice which can be procured.

After an open sore forms, a soothing ointment, such as the ointment of oxide of zinc, or Goulard's cerate, or cerate of the oleate of lead, with morphia if there is much pain, may be tried, but after a time it is often found that greasy applications cause some irritation, and flaxseed poultices, or lead-water and laudanum, made by diluting half an ounce each of Goulard's extract of lead and laudanum with three ounces of distilled water, applied on soft linen rags, and covered with oiled silk, which may be held in its place by a little adhesive plaster, melted in a candle flame and spread on to a small spot at each of its four corners, will serve an excellent purpose. When the ulcer grows larger, and the discharge commences to give out its horribly putrid odor, it will be necessary to use disinfectants, such as carbolic acid in the water-dressing, or, if found irritating, sprinkled on lint outside of the direct application to the sore. When the odor of carbolic acid is very disagreeable to the patient, the white crystallized preparation should be used, or the solution of permanganate of potash may be employed, both for washing the sore thoroughly, and as application upon soft cloths. Poultices of ground animal charcoal, enclosed in a bag of fine cambric, or made into a paste with flaxseed, have often done good service in correcting the stench of bad, cancerous sores.

## COLLOID.

This new growth, formerly called colloid cancer, gelatinous, or gum cancer, is no longer considered to be malignant, in the sense of its having the power to infect other and distant portions of the system. Its great characteristic is the formation of a new growth in the large open meshes of which exists a glue-like, gelatinous, transparent substance, like half-dissolved gum arabic. Although not apt to be reproduced elsewhere, these growths may attain an immense size, and even prove fatal by the disturbances which they cause in the system. Fortunately they are quite rare in American practice.

## LUPUS.

This a spreading, tuberculous inflammation of the skin, usually of the face, tending to destructive ulceration. Its name is supposed to be derived from a fancied resemblance which the sores left in the progress of the disease have to the bite of a wolf. Lupus seems to have the power of extending itself through any structure which lies in its path, and in this respect has been considered as allied to cancer, but it is nevertheless more like scrofula in its other manifestations. In this disease lumps or nodules are formed in and under the skin, causing much thickening of the integument, and the new growth advances from the cutaneous surface to the deeper lying layers, invading even the cartilages and bones. Crusts, partly made up of the dead and dried skin, next form over these little tumors, under which the deeper portions soften and ulcerate. Sometimes, however, the inflammation about the new formation seems to subside, the cell-elements undergo fatty degeneration, followed by absorption, and a cure spontaneously occurs, although deep, excavated scars are usually left to mark the former existence of the complaint.

The two varieties recognized are *chronic lupus* and *lupus excelsus*, a form characterized by the rapidity, depth, and extent of the ulceration, and by its appearing in rare cases on other parts besides the face. Chronic lupus is uncommon before the tenth year of life, and still more rare after the fortieth, being most usual between ages of ten and twenty. It is less frequent among the rich than among the poorer classes.

*Treatment.*—In the treatment of lupus, unlike that of cancer, internal medicines are of real value, by improving the condition of the general health. Quinine and the other vegetable tonics, cod-liver oil, and iodide of potassium, are all useful in this respect. The local treatment consists in the thorough removal of the new growth, which may be done by the surgeon's knife if the case is seen early enough, or, if the disease is so situated that this is difficult or impossible, the more painful method of applying caustics, such as caustic potash or arsenic, may be employed.



RODENT ULCER is a destructive sore, characterized by the extent and depth to which it spreads in the adjoining structures, and by the absence of both preceding hardness and constitutional infection. In these respects it differs from lupus, as well as in the fact that rodent ulcers are more apt to occur after the age of forty than in the earlier half of life.

### TRUE LEPROSY OR ELEPHANTIASIS OF THE GREEKS.

This is a constitutional, hereditary affection, essentially chronic in its nature, showing itself mainly as shining tubercles of different sizes, of a dusky red or livid color, on the face, the ears, and often on the legs, the skin being thickened, wrinkled, rough, unctuous, devoid of hair, and the perspiration from it highly offensive. After a time there is loss of sensation, and a tendency to ulceration and death of the parts. In the advanced stage of this disease, the eyes are fierce and staring, and the voice hoarse and nasal. It is now generally considered by the best authorities that leprosy is not usually a contagious disease, but is propagated by inheritance, depending on some specific taint transmitted from parents to children. The two forms of this horrible disorder which are described by medical writers, are the tuberculated leprosy, and the non-tuberculated or anæsthetic. The former presents the following characters: Tumefaction or tubercular thickening of the skin, principally of the face and the arms, and legs, but less evident upon the trunk. The affected skin is discolored, dark brown, bronzed, or shining, with the sensibility diminished or entirely lost. The mucous membrane of the mouth and throat ultimately becomes affected, and the voice altered. Contraction of the fingers and toes is a frequent symptom, and the first or second joints of the fingers may drop off from ulcerated cracks forming over the articulations, or from mortification due to this ulceration cutting off the blood-supply. The entire hand or foot may thus be lost. Finally the constitutional disturbance is much greater in this than in the other form.

The non-tubercular or anæsthetic variety, which is most frequent in India, is marked by the following characteristics: Anæsthesia or loss of sensibility of the skin of the face, ears and limbs, succeeded in the latter case by withering, wasting, and occasionally ulceration of the benumbed parts, especially of the fingers and toes, with little or no general disturbance of the rest of the system. Large, circular, superficial ulcers may form on the legs, and after a while the fingers and toes become contracted, the joints enlarged, the ends of the fingers, broad, flat, and clubbed.

The only hope of exterminating this dreadful disease appears to lie in the adoption of hygienic measures tending to improve the general condition, both physical and moral, of the leprous poor. Without this, medical treatment is of little or no avail, but with the aid of improved sani-

tary surroundings, tonics and alteratives, especially preparations of iron and iodine, have a very beneficial effect. Much may be hoped also from the systematic employment of baths, either saline or sulphuretted, in this affection.

By some observers leprosy is thought to be a non-contagious disease, and at any rate it is not supposed to be contagious through the atmosphere or by ordinary intercourse, but to require, like syphilis, contact with the blood or secretions of an affected person. The period of incubation is believed to be from twelve months to sixteen years. One case is reported of a Catholic priest, who, whilst ministering to a family of lepers in this country took the malady and died of it in a short time. In another instance a child was inoculated in 1843, by being vaccinated with vaccine matter from a leper. This unfortunate subsequently came to this country and died of the disease in the Bellevue Hospital, New York. A very competent observer, Dr. White of Boston, says of it: Its origin is older than history, and it does not appear to have changed in many thousands of years. It prevails over large portions of the earth's surface, and we have at present three centres of it in the United States. One of these centres is in Louisiana, another in the Northwest, and a third on the Pacific Coast, affecting three entirely different nationalities, in different climates, and under quite diverse modes of life. In San Francisco there are numerous cases, chiefly among the Chinese, who are cared for in a hospital under municipal control, their countrymen regarding these unfortunates with the utmost abhorrence. Besides these three starting-points in our own borders, colonies of lepers are reported to exist near the Atlantic coast of the neighboring British possessions. Dr. White believes that there is danger of its spread, and that it ought to be controlled by isolation and the prohibition of the immigration of lepers. The danger is no doubt small, that is to say there is very small risk of a very great danger, but it does exist, and now is the time to guard against it.

A bacterium claimed to be the cause of leprosy, and named the *Bacillus lepræ*, was discovered in Norway in 1874, and its existence in the tubercles of this disease has been confirmed, although its causative power has not yet been completely demonstrated.

### SCROFULA.

This is a common constitutional affection, showing itself generally in physical weakness of the body, with external swellings of the glands, these often ending in suppuration, that is, the formation of matter. In some instances there is a deposit of tuberculous substance, or that material which is concerned in the production of consumption of the lungs, in different structures of the body, as for example in the mesenteric

glands. To this condition of, or tendency in, the body, the name of the scrofulous diathesis has been applied. There are two varieties of this malady. The first is described as scrofula without tubercle, and the second as scrofula with tubercle.

Some disturbance in the balance between the nutritive and the dissimilative processes going on in the solids and the fluids of the body, lies at the foundation of the development of the scrofulous state. In cases where the tendency to the growth of tubercle is hereditary, the mode in which agents from without operate is for them to act as excitants to its growth. Ever since scrofula has been more profoundly studied, as a constitutional affection, it has become more generally recognized that impairment of the digestive organs is the primary disorder of function which ushers in the cachexia, and that a certain form of dyspepsia is not only present as a rule in the hereditary scrofulous, or strumous, as it is often called, constitution, but is capable of generating the evil habit of body, and of leading, ultimately, to the growth of tubercle.

The most important manifestation of scrofula with tubercle is that of consumption of the lungs, which will be considered in the chapter upon pulmonary diseases.

Scrofula without tubercle, known also by the names of external scrofula, struma, and in former times as "king's evil," manifests itself chiefly by glandular swellings, more or less extensive ulcerations, and indolent abscesses. Cases of strumous ophthalmia, or scrofulous inflammation of the eyes, are also lamentably common, and the same may be said of scrofulous diseases of the bones and joints.

Scrofulous inflammation of the lymphatic glands, or strumous adenitis, is one of the most common consequences of the scrofulous cachexia. The glands of the neck, and especially those about the base and angle of the lower jaw, are probably more frequently affected than any others. The subjects of this manifestation of the disease are especially young children, although it also displays itself similarly in older persons. There are rarely any premonitory symptoms to attract notice, the first indication being generally an indolent swelling of one or more of these glands, without marked constitutional disturbance. This enlargement is usually attributed to taking cold, and such indeed very frequently appears to be the exciting cause. The swelling often remains almost stationary for months, or even for years; but if, through any accidental influence, additional irritation is set up in these enlarged glands, and especially if a tendency to suppuration is excited, the general system begins to suffer as a consequence. The already unhealthy patient becomes irritable and restless, a low kind of fever makes its appearance, the tongue gets furred, the bowels grow costive, and the appetite fails, whilst the urine is found scanty and loaded with urates. Unhealthy discharges also frequently take place from the ears, nose and eyes, and other parts. In



cases where the general health is already very bad, or when it gradually becomes so, the inflamed glands rapidly undergo disorganization, the surrounding skin and connective tissue become involved, and extensive, indolent ulcerations result. The position of these ulcers, when they do heal, sometimes after years of troublesome discharge, is always afterwards indicated by unsightly scars.

*Treatment.*—In the constitutional treatment of these cases of strumous adenitis, nutritious food, suitable warm clothing, attention to cleanliness, and residence in pure air are the most important requisites. Hence the invalid should have all the advantages of an abundance of good mutton and beef, vegetables and ripe fruits in season, raw eggs, milk and cream, cod-liver oil, tepid or cool baths, and sea air. Iodine in its different forms, especially the iodide of iron, is often given, with benefit, in doses of twenty-five drops of the syrup of iodide of iron thrice daily, and quinine and iron, each in grain doses three times a day, with one-sixteenth of a grain of arsenic, or phosphites and hypophosphites of lime and magnesia, in table-spoonful doses of the syrup, are frequently of great service. In endeavoring to produce a reduction of the swollen glands by causing an absorption of their contents, the tincture of iodine painted on with a camel's hair brush, or small feather, so as to smart severely, but not to raise a blister, and repeated daily for a week or so, until the skin peels off, is a valuable resource. A milder application of the same remedy is by the use of the ointment of iodine, rubbed into the skin over the enlarged gland, night and morning, for weeks or even months if requisite. When suppuration takes place, as it will in spite of diligent treatment in a large proportion of the cases, poultices should be applied, and the treatment must be that generally recommended in abscess.

Scrofulous ulcers are a common indication of the scrofulous cachexia, and are more often seated upon the neck, shoulders, arms, and hips, than elsewhere. By their gradual extension, large areas of skin may be destroyed. The efforts of nature to repair this loss of tissue, even when exerted, are generally slow and imperfect, and any granulations which appear about the edges are almost sure to be exuberant and flabby, presenting the characters of what is popularly known as "proud flesh" in the sore. The general health, usually bad from the beginning, is still further undermined by the wasting discharge of unhealthy pus or corruption, and the only hope of cure is by the aid of such constitutional remedies as have already been pointed out. After the general condition of the system has been improved, however, by the judicious administration of the so-called anti-strumous remedies above mentioned, and especially by the employment of sea-air and sea-bathing, healing of these ulcers may often be secured, especially if the unhealthy proud flesh is destroyed by the occasional application of caustics, such as nitrate of silver. As a dressing, the solution of carbolic acid, in the strength of

ten grains of the crystals in the ounce of water, is highly recommended.

Strumous abscesses often commence insidiously in the connective tissue, or they may have their origin in the suppuration, which frequently follows glandular inflammation. They are very apt to become indolent, that is, pass into a condition where, without any tendency to heal, they continue to discharge and drain the strength of the patient, or they may suppurate imperfectly, or again they may burrow in all directions. In this way long channels or sinuses are formed beneath the skin, from which exudes a thin, watery and unhealthy matter called sanious pus. Although hasty interference is to be avoided, it is often judicious to open these sinuses with the knife. This is advisable, not only because their cure will thus be very much hastened, but also because the narrow, linear scar thus left is very much less disfiguring than the rough and irregular one which will result from allowing the skin to ulcerate of itself, as there is little doubt must occur before the sore can heal. Moreover, by a neglect of this little operation, when the abscess has occurred over one of the long bones, such as that of the leg, inflammation and destruction of the bone itself, and perhaps lameness for life, is very liable to result.

Strumous ophthalmia occurs in children between the time of weaning and the end of the ninth or tenth year. Its chief symptoms are redness of the white of the eye, with the formation of little blisters or pustules, often ending in minute ulcers on the cornea or clear portion. The eyes water very freely, and the intolerance of light is excessive, so much so as almost to be indicative of the disease. This dread of light causes the eyelids to be spasmodically contracted the moment any attempt is made to examine the organs of vision, and makes the child spend most of its time hiding its head in some dark corner or constantly shading its eyes with a handkerchief. Both eyes are usually affected. In addition to the trouble with the eyes, the little patients often present themselves with swellings of the lips, eruptions behind and within the ears, and around the nostrils, as well as disorder of the bowels. Even the tears which flow so abundantly from the diseased eyes are irritating, and may give rise to a troublesome rash upon the cheeks with which they come in contact.

*Treatment.*—The management of these cases will tax the skill of both nurse and doctor to the fullest extent. Although internal remedies are often also required, the nursing and outward applications are the most important. Great attention must be paid to cleanliness, and warm bathing of the eyes with anodyne fomentations are very serviceable. Applications of the wine of opium, or of a solution of nitrate of silver, of a strength of from five to ten grains in the ounce of water, although they smart severely at first, are often of very great benefit. In obstinate cases small blisters behind the ears, or upon the temples, should be employed, and it is wonderful how rapidly the eyes improve in some cases when a



discharge is established behind the ears. Great care should be taken to follow out nature's excellent suggestion, and protect the visual organs of the child from the stimulating and irritating influence of the light. In the house a green shade ought to be worn, and out of doors a grey or blue veil should not be laid aside for a moment.

### RICKETS.

This is a disease of early childhood, characterized by an unhealthy state of the system, which precedes for several weeks or months a peculiar affection of the bones, manifested by curvature of the shafts of the long bones, and enlargement of their spongy extremities. Some of the solid viscera in the interior of the body also exhibit peculiar alterations. The earliest recognition of the cachexia associated with rickets can rarely be made before the fourth month of infant life, and usually not before the twelfth month. Often it does not declare itself until the child begins to attempt walking, or until he commences to suffer with his first teeth, and the progress of the disease may be primarily so very slow as to be almost imperceptible.

The cause of rickets seems to be anything which induces enfeebled assimilation of food and impaired nutrition of the body. Hence this affection is sometimes met with in such weakly children of even wealthy parents as suffer from defective action of the vital forces. Like scrofula, it is, however, especially a disease of the poorer classes. Insufficient and especially improper food, the constant respiration of foul, impure air, residence in dark, damp, cold or filthy dwellings, these and similar circumstances readily serve, in all probability, to generate rickets. Again, the children of parents who have weakened themselves by sexual excesses, or who have married too early or much too late in life, or those whose constitutions before they entered into matrimony had been impaired by venereal disease, or by a strumous taint, or by unhealthy occupations, as well as the offspring of delicate, anæmic mothers, are, it is probable, more or less exposed to this disease. Not that it has been proved that rickets is hereditary, but the health of the parents, if deteriorated, must have a tendency to transmit itself to the child, and render it liable to yield speedily to the disease when the exciting causes of rickets are brought into action. A French experimenter, M. Guérin, has proved by observations upon animals the possibility of producing rickets at will by merely separating the young too early from their mothers, and supplying them with food suitable only for the adult. There no question that in these cases of improper feeding partial starvation is induced, both by the imperfect assimilation of food and by the diminution of digestive power which is brought about; but that the same result is sometimes produced in the human infant can scarcely be doubted for a moment.



When a little child is threatened with an attack of rickets, the first indication that some morbid process is going on in the system is generally shown by languor, with an occasional feverish condition of body, sadness and irritability of temper, copious perspirations about the head, and general tenderness of the trunk and extremities, the infant often complaining causelessly, as it seems at first, of being hurt when moved or touched. Soon there is some swelling of the abdomen, irritation of the alimentary tube, diarrhœa, general debility and wasting, with slightly painful swelling also of the wrists, knees, and ankles. The transition from apparent health to disease is gradual, and occasionally only marked by the presence of some slight ailment. Very frequently a considerable period elapses between the actual commencement of the disease and its certain detection, and even when a watchful parent or physician has early recognized the cachexia, it is commonly several months before any actual deformity makes itself manifest.

The longest bones in the body, those of the thigh and leg, are among the first to exhibit a change from the natural form. The legs begin to bend outwards at the knee, giving rise to the deformity of bow-legs, or less frequently the knees are thrown forward and the feet outward, making the child what is called knock-kneed, and usually crippling it more or less for life. The bones of the arms and the collar bones may also become very much curved and twisted, showing that the popular delusion as to the cause of bow-legs, namely, that the child was allowed to walk too early, has little foundation in fact. The deformity of the chest is often very great, the back being flattened, the breast bone pushed forward, and the natural curve of the ribs lessened. In such cases the child is said to be pigeon-breasted. The flat bones become thickened, and there is a real enlargement of the ends of the long bones. Deformity of the large bones of the pelvis is common, and in female infants may lead to lamentable trouble in after life should the girl live to grow up and marry; the spine also sometimes grows twisted in various ways. In children thus affected the head frequently appears disproportionately large, the face becomes pale, and the features attenuated, whilst the eyes are unnaturally bright and have a staring expression. As these changes progress the appetite is poor or capricious, and the powers of digestion become much impaired, so that the food may pass through the intestines only half-digested, and at any rate the evacuations are apt to be pale or slate-colored, and very offensive. The respirations are quickened, and the pulse grows frequent and feeble. The urinary secretion is more abundant than in health and loaded with earthy phosphates, especially the phosphate of lime, such excess being probably due to this salt being gradually drained away from the bony framework of the sufferer's body. This is shown to be the fact in fatal cases, by the circumstance that after death the bones are often found soft, spongy, and pliable, owing to the diminution of their earthy con-

stituents, particularly the phosphate of lime. This softening of the bones may be so great that they can be easily cut, or bent between the fingers, and on an average it is stated that in rickets the affected bones contain two-thirds less of earthy matter than should be present. In addition to these symptoms it is noticed that rickety children manifest a tendency to chronic dropsy of the brain, to bronchitis, to diarrhoea, and to a peculiar disease of the liver, spleen, and lymphatic glands, called amyloid degeneration.

During the last stage of the disorder the child may either sink from simple anæmia and exhaustion, or fall a victim to some complication in the form of pulmonary or intestinal disease. More frequently, however, under the influence of proper treatment, a happier result is obtained, and the functions are restored, at first slowly, but afterwards rapidly, to a natural state. The earliest signs of improvement are usually a more healthy condition of the excretions from the bowels and kidneys, and an increase particularly in the digestive powers. As the appetite improves the flesh becomes firmer, the languor, dulness and feverish symptoms all subside, growth proceeds rapidly, and the swollen condition of the abdomen disappears. The disease of the bones is also arrested, and healthy bony material is actively deposited at those parts where the weakness is the greatest, that is to say, where the curvature was most marked. As day by day the general health improves, the bones become firmer and harder, until at length only the deformities produced by the curvatures remain to show during life how the individual has once been affected.

The diagnosis of rickets must, of course, be difficult in the early stage, as the symptoms closely resemble scrofula at that time, but after the curvature of the bones commences there can no longer be any doubt, as such softening of the bones during childhood only occurs in rickets.

*Treatment and Diet.*—The medical treatment of rickets must be subordinate to the hygienic, since far more depends upon good food, proper clothing, and pure air, than on drug medication. Milk diluted with lime-water, Liebig's food for children, and, if the infant is old enough, beef-tea, extract of beef, raw meat, eggs, and so forth, should be given in abundance. The phosphates or hypophosphites of iron, lime, quinine, and strychnia, as recommended when speaking of scrofula, are very useful, and if the child is capable of digesting cod-liver oil, it ought also to be administered. Should the diarrhoea be troublesome, a chalk and soda mixture, containing a grain of each as a dose for a baby one year old, or a mixture containing a grain of bismuth in each dose for an infant of that age will probably be of essential service, and after the feverish symptoms are controlled the child, in suitable weather, should almost live in the open air, especially if a seaside atmosphere can be obtained.

### CRETINISM.

This is defined to be a condition of imperfect development and deformity of the whole body, especially of the head. It occurs especially in the valleys of certain mountainous districts, such as those of the Alps, in Switzerland, is attended with feebleness or absence of the mental faculties, and of the special senses, and is often associated with goitre or enormous swelling of the glands of the neck.

The three varieties of cretinism which have been described are, first, complete or incurable cretinism, which is characterized by idiocy, deaf-dumbness, deficiency of general sensibility, and entire absence of the reproductive power; second, semi-cretinism, which is a degree of the malady in which the mental faculties are limited to the impressions of the sense and the bodily wants. The general sensibility is obtuse, the head is badly formed and drooping, the speech is rudimentary, and the reproductive powers are feeble or absent; third, incomplete or curable cretinism, is the term applied to a degree of the complaint in which the mental faculties, though limited, are capable of development, the head is moderately well formed and erect, and the special senses, the faculty of speech, as well as the reproductive powers, are present. With but few exceptions, cretins are sufferers from goitre, and it is said that where both parents have had goitre for two generations in succession, the offspring, constituting the third generation, are sure to be cretins.

### DIABETES OR DIABETES MELLITUS.

In this remarkable disease there is an excessive discharge of urine containing grape-sugar, the saccharine principle of grapes and of honey, called glucose, being produced in the body in great quantity, and eliminated from the kidneys. The exhaustion, which results from the immense loss of fluid, sometimes amounting to several gallons daily, is often accompanied by other disturbances of the system, due to the presence of sugar in the other secretions and in the blood, and to the modifications of the nutrition thus effected. Opacity of the crystalline lens of the eye, constituting diabetic cataract, is occasionally one of the modifications of structure; shrinking of the substance of the brain is another, and a peculiar form of inflammation of the lungs is another. It is a disease which commonly, after a longer or shorter course, proves fatal.

The early symptoms of diabetes are obscure. It has been thought by some physicians that there is a stage which precedes the formation of sugar, and which is marked by a superabundant and highly dense urine, loaded with an excess of urea. Nothing is assured, however, upon this point, except that the constitution is not much affected until the saccharine matter forms and is eliminated by the urine. In some few instances the



amount of renal secretion is hardly greater than in health, but cases are often seen where the quantity of urine passed amounts to from two to four gallons daily. In this bulk of fluid there may be from one to two pounds of sugar.

The onset of the disease is thus, as a rule, insidious and escapes observation. There may be a sense of general discomfort, and some emaciation may be noticed, whilst after a time troublesome thirst and a frequent desire to empty the bladder, are well-marked symptoms in nearly all cases.

After a longer period the general health commences to give way, and the thirst becomes constant and intense, requiring many quarts, or even gallons, of water to satisfy it. The appetite is capricious, but generally excessive and voracious, the skin harsh and dry, emaciation becomes extreme, and the reproductive powers are lost. Almost all the water imbibed passes off by the kidneys, and the insensible perspiration is diminished, both by skin and lungs. The amount of fluid eliminated from the intestinal canal is also very much diminished, and hence the bowels are costive, and the evacuations, when procured, dry and hard. In advanced cases the drain upon the system is so great that the alveolar processes, which form the sockets of the teeth in the jaws, are absorbed, and the teeth loosened in their position are apt to fall out. These symptoms may be much relieved by proper medical treatment, and life much prolonged. But often when the case appears the most favorable, destruction of the lungs makes its appearance, and the patient sinks under the accumulated load of disease.

The recognition of diabetes is not difficult when once its existence is suspected, and this should always be the case, if a person is found to be passing a large amount of urine. A faint, sweetish odor is sometimes perceived, and occasionally attention is called to the existence of diabetes by the saccharine condition of the urine attracting flies. When any suspicion on this point arises, however, the specific gravity of the renal secretion ought to be examined with the hydrometer, and if found above the natural standard, the cupro-potassic test for grape sugar should be at once applied. Among the various modifications of this test, the simplest and most convenient is that of Trommer, which consists in boiling the suspected urine in a test-tube, with a couple of drops of solution of sulphate of copper and half its bulk of caustic potash solution. If sugar is present a reddish brown or brick-red precipitate will be produced.

*Diet.*—Since it is found that the amount of sugar discharged in the urine fluctuates very much in accordance with the starchy and saccharine materials which are eaten, it is best for the diet of a diabetic patient to be freed, as far as possible from substances which can be converted into glucose by the digestive organs. Hence the effort should be, in treating diabetes, to abstain from all starchy food, as well as from every solid and liquid containing sugar. Fat meat and eggs may be taken, as derangement of

the liver is not found to be produced by them, and fish is a most important article with which to vary the monotony of the diet. Skimmed milk seems to answer a very good purpose in this disease, as the sugar of milk which it contains is apparently not very readily converted into glucose. Its effect in any particular case ought to be carefully watched, and frequently determined by testing the urine for the quantity of sugar daily eliminated. A distinguished Philadelphia physician has compiled the following diet table for persons affected with diabetes, and has proved its value in numerous instances. By living according to its recommendations, a diabetic patient may generally enjoy comparative health and comfort for many years, and even a hope of permanent cure may be entertained. Moreover, as the elimination of saccharine and starchy substances from the diet has proved beneficial in nervous prostration and brain exhaustion, even when these disturbances are not associated with the presence of sugar in the urine, the same bill of fare may be wisely given a trial in obstinate cases of these affections also: Oyster and clams may be eaten raw, or cooked without any flour mixtures. Soups may be partaken of, provided they are not made with flour, rice, vermicelli, or any of the prohibited vegetables. Fish of all kinds, including lobsters and crabs, may be eaten. Meat of all kinds, especially beef and mutton, but liver had better be abstained from. So also with poultry and game, which may be indulged in freely, but the jellies and sauces so often served with the latter ought to be avoided. Salads may be eaten in all varieties, except potato salad. The patient may use freely spinach, lettuce, watercress, brussels sprouts, chiccory, dandelion, and coldslaw; cabbage is particularly useful. Olives may be allowed. The forbidden vegetables are potatoes, beets, carrots, turnips, parsnips, peas, beans, rice, or others containing sugar or starch. Young onions have been found especially serviceable. Sour apples, cut into quarters, dipped into beaten eggs, rolled in cooked gluten flour, and fried in very hot fat, are sometimes a very acceptable substitute for potatoes. Most kinds of tart fruits may be eaten. Peaches and strawberries with cream, but no sugar, have been allowed plentifully without injury. Milk should be used in moderation, but cream, butter, buttermilk, and all kinds of cheese, may be taken without stint. Among the nuts, almonds, walnuts, filberts, and pecan-nuts, may be used. No pastry should be eaten unless made from the gluten flour and without sugar. Eggs ought to be eaten plentifully, but if boiled the time should not exceed two minutes. They must not be partaken of in sweet omelettes or custards. Coffee and cocoa must be resorted to in moderation, and sweetened with glycerine instead of sugar. Tea is considered objectionable, as are all kinds of spirits, wines, and malt liquors. When a stimulant is necessary the least injurious is weak brandy, or whisky and water, or acid Rhine wines. The food should be eaten slowly and in small quantities at a time, drinking as little fluid at meals and throughout the day as possible.

*Treatment.*—In diabetes the tendency is to dryness of the skin, and therefore the promotion of perspiration is very important. Hence frequent warm baths are advised, the evening being generally the most appropriate period of the day for bathing. If the patient is not too much debilitated, tepid or cold baths may be taken in the morning, exercising afterwards in order to restore the activity of the circulation. Turkish baths are also recommended, if approved by the attending physician as applicable to the particular stage of the disease.

Among the medicinal remedies opium, in one-grain doses twice or thrice daily, is the most important, and under its use not only is the patient greatly soothed, but the general symptoms are mitigated, and the specific gravity of the urine is lowered, showing an actual diminution in the amount of the sugar excreted. As there is no such terrible danger of its poisonous effects from small quantities as occurs in Bright's disease, the opiate may be given in full and increasing doses, until perhaps from eight to twelve grains of the extract are consumed in twenty-four hours. Sometimes codeia is found to answer the purpose better than opium or its extract, producing less tendency to sickness at the stomach, and not requiring to be so rapidly increased. By its use it may perhaps be possible to avoid the formation of the dangerous opium habit, or at least for a longer time postpone the oncoming of this melancholy lesser evil. As tonics, quinine, two to four grains thrice daily, strychnia, in doses of one-twentieth of a grain three times a day, and the citrate of potash or of ammonia with iron occasionally prove very valuable. Dr. Flint recommends Clemens' solution of the arsenite of bromine very highly in diabetes.

A variety of diabetes is that called *Diabetes insipidus*, because there is no sugar secreted into the urine by the kidneys. It resembles the more dangerous disease in the large amount of the renal secretion produced, but may at once be distinguished from *Diabetes mellitus* by testing the urine in the manner already described. This variety is more frequently met with in females than in males, and is less fatal as well as less common than the other form. It is a malady which is especially apt to occur about the age of puberty, but its causes and nature are not at present very well understood.

### PURPURA OR LAND SCURVY.

This is a complaint not usually attended by fever, and characterized by purple spots under the skin, which are not effaced by the pressure of the finger, and are generally of small size except where they run together in patches. The two varieties which are distinguished are the simple and the hemorrhagic, in the latter of which the malady is accompanied by bleeding from some of the mucous membranes of the body. It has not



yet been determined what is the nature of the morbid condition in purpura, except that the blood has lost its power of coagulation. A peculiar source of danger in this disorder is the tendency to the pouring out of blood into one of the internal vital organs. In this way the brain, the lungs, and the liver may be affected with serious or even fatal results. Instances occasionally are seen in which the blood oozes or is discharged more or less copiously from the mucous membranes without any spots of purpura appearing upon the skin. And in this class of cases are to be arranged the remarkable conditions included in what is called the hæmorrhagic diathesis, which is believed to be hereditary in families of "bleeders," in whom any slight wound, even the scratch of a pin or the extraction of a tooth, may prove fatal by resulting in hæmorrhage which cannot be checked.

Various symptoms denoting general disorder of the system precede the appearance of the spots, or petechiæ in purpura, generally for some weeks. In most instances languor, weariness on very slight exertion, faintness, and gnawing pains in the stomach are complained of. The appetite is variable, generally poor, but sometimes there is an inordinate craving for food, which, however, when eaten is not digested, and is said to lie as a heavy weight upon the stomach. The tongue is yellowish and coated with a viscid fur, the countenance sallow or dingy, or the face may have a pale and bloated appearance, with swelling beneath the eyelids. The purple spots usually first appear upon the legs, and afterwards without any certain order on the thighs, arms and trunk of the body, and their formation is attended with great weakness and much depression of spirits. No degree of pressure alters the color of the spots, and they are thereby distinguished from the eruptions of any of the contagious diseases except those of typhus and spotted fever. They may be discriminated from flea-bites, which they occasionally resemble, by the absence of any central puncture. At first they are bright red, but in a day or two they become purple, afterwards brownish, and when they are about to disappear they assume a yellowish aspect. When the disease has continued a long time, all these varieties of color may be found upon a patient at the same examination. The changes in each spot are exactly the same as those which take place in the blood effused under the skin after a bruise, and indeed the condition is precisely similar, except that the blood is then poured out from little blood-vessels broken by the force of a blow. In a purpuric condition of the system the pulse is feeble, and generally a good deal quicker than natural. Deep-seated pains are felt about the region of the stomach as well as in the chest and loins. In some instances giddiness and lightness of the head prevail, especially upon attempting to walk or stand erect, and not infrequently a dull pain is felt in some part of the head. Constipation of the bowels, palpitation and irregular action of the heart, with a tendency to frequent syncope or fainting fits, are the

most distressing and dangerous symptoms. When the disease is very protracted, the patient becomes of a sallow complexion, waxy-colored and dingy, dropsical swellings of the feet and legs with deep and gangrenous sores appear, general dropsy often prevails, and the sufferer dies exhausted.

*Treatment.*—In the treatment of this disease, that golden rule of curative medicine, to find out the cause and remove it, is, if possible, doubly important. At the same time tonics, such as quinine or Peruvian bark, the diluted mineral acids in five- or ten-drop doses, iron and strychnia as already directed are of great importance, and the most nutritious food with wine and other stimulants, may be required. The oil of turpentine administered in moderate and repeated doses of ten drops in emulsion of gum arabic, thrice daily, is highly recommended in the treatment of this malady.

### SCURVY.

This is a disease allied to purpura, but attended with a spongy condition of the gums, and livid patches under the skin of considerable extent, which are harder than the surrounding structure. The complaint is common at sea among those who have been long kept upon salted provisions and exposed to much hardship. It has been stigmatized as the great plague of the ocean, and has been often denominated sea-scurvy, to distinguish it from land-scurvy or purpura.

One of the earliest symptoms of scurvy is a change in the color of the skin, particularly about the face and eyelids. The integument around the orbit of the eye may be puffed up in a bruise-like swelling. At the same time there are vague wandering pains in the limbs, weariness, depression of spirits, and an intense craving for vegetables and fresh fruits. With these symptoms, however, there is no fever, the pulse is soft and natural, and the temperature of the body, as shown on testing with the thermometer, is even lower than the usual standard. As the disease progresses, the countenance becomes pale, or yellow and bloated, there is great depression of the physical powers, followed by the characteristic indication of swelling of the gums, which become soft, spongy, and hang over the teeth in large fleshy fungoid-like masses, very much disposed and readily excited to bleeding. The edges of the gums are usually purple where they come in contact with the teeth. It is a curious fact, however, that in old people without teeth these vegetations do not occur, and the gums remain comparatively unaffected. In one case it was noticed that a single remaining tooth was surrounded by a mass of swollen gum, and when this tooth was extracted the gum soon became level and firmer, whilst the other symptoms of the complaint preserved their intensity. The swollen and fungus-like gums have always appeared

to be more intensely marked in cases of scurvy occurring on shipboard, and it is not improbable that they are thus peculiarly affected, because they are there exposed to an unusual pressure and attrition, from the hard food commonly supplied for sailors. Sometimes the gums are severely ulcerated.

A remarkable peculiarity of scurvy is the readiness with which all parts of the body suffer from pressure, and the slightest possible blow may produce an extensive bruise. A small eruption like flea-bites is often to be seen on the legs, and about the same time the muscles of the legs and thighs are apt to become hard and painful, and in a day or two the skin over the painful part grows yellow and then purple. These purple spots may be as large as the palm of the hand at first, and are liable to extend until they cover half of the limb. As the disease advances all the symptoms become aggravated. The loss of physical power increases, the purple spots have a tendency to ulcerate, and the resulting ulcers are especially distinguished by their putrid fungoid appearance, and their great tendency to bleed. In this stage of scurvy old sores open, and the callus, or uniting material which has knit together broken bones, perhaps a long time before, may even be dissolved so that the fragments of bone are separated. Towards the close profuse hemorrhages take place from the mouth, nose, lungs, or bowels, and sometimes from large blisters which form on the mucous surface, and when they burst discharge blood instead of serum. Finally the patient sinks exhausted with diarrhoea or by dropsy, which by some rapid effusion around the heart, or upon the brain, may cause sudden death.

*Treatment.*—The great remedy for scurvy is lemon or lime juice, and in British vessels the rules are to serve out to all the sailors four table-spoonfuls of either of these fluids twice a week, or should any symptoms of the disease make their appearance, to increase this dose to two tablespoonfuls every day. The giving out of the lime or lemon juice ought not to be delayed longer than a fortnight after the vessel has put to sea. As there is often difficulty in keeping lemon juice in hot climates, attempts have been made to substitute its sour principle, citric acid, but without entire success. Besides these juices, every effort should be made to keep up a supply of fresh vegetables and fruits, especially potatoes, oranges, grapes, cabbage, and so forth. Dr. Parkes declares that unripe fruits are better than none, and we must risk a little diarrhoea for the sake of their power as preventives of scurvy. In time of war every vegetable should be employed which it is safe to use, and when made into soups nearly all of them are tolerably palatable.



## ANÆMIA.

This is a special, morbid state, in which there is paleness of the surface of the body and deficiency of the red corpuscles of the blood. It is a common affection amongst women, and persons of both sexes who are ill-fed, or from any cause badly nourished, in crowded localities. Not only is the number of the red corpuscles diminished, but the whole quantity of the vital fluid is decreased, and the plasma, described on page 155, is watery, poor in albumen, and contains an excess of salts. A reduction in the quantity of blood and the impoverishment of its constitution rarely occurs alone, but is generally a morbid state resulting from many exhausting morbid processes, peculiar to certain wasting constitutional diseases. In many of these maladies where the whole bulk of the blood is evidently diminished, it is indicated by the small, almost thread-like pulse, the pallor and bloodless appearance of the countenance and of the whole body generally, but especially of the lips and gums, and in the slender blue and collapsed veins, particularly obvious by contrast to the pallid skin. In such cases one would never think of drawing blood to find out whether its composition had changed, but as far as the red corpuscles are concerned, their number can be accurately counted in a very small drop, and occasionally when opportunity to examine a larger quantity of blood, in consequence of the occurrence of some accidental hemorrhage, the chemical alterations above described have been discovered. The exact causes of the diminution of the red corpuscles, which constitutes anæmia, are very obscure. By some physiologists it is attributed to the action of the spleen and glands, in some abnormal way, whilst others contend that it results, at least in some cases, from disease of the marrow of the bones, where it is supposed that the white blood corpuscles are changed into red ones.

The results of this morbid change in the blood are evidenced in alterations of the vascular system generally, and also in the metamorphoses of the structures of the body, upon the balance of which health depends. In the first place, the blood-vessels contract, as would be expected, in proportion to the diminution of the blood-mass, the pulse, wherever it can be felt, is found to be small, the capillaries are reduced in size, and the heart, not being stimulated to do its full duty by the presence of its natural excitant, rich and healthy blood, becomes weak and irregular in its action, so that the whole circulation is profoundly disturbed. In regard to the changes which go on in the tissues of the body, and which, as has been already explained on page 156, are essential to life, the muscles and the nervous system appear to be the first to suffer. Debility and prostration, both physical and mental, occur. In severe cases, sensation may be lost, fainting fits are very apt to come on, and even death may result. The exhausting diseases which are especially liable to lead to the production of anæmia, are Bright's diseases, cancer, and prolonged suppuration

or discharge of pus, such as occurs from scrofulous abscesses. As the complaint progresses, diarrhœa or general dropsy are apt to make their appearance, and aggravate the prostration of the system, until a fatal issue terminates the sufferer's existence. The diagnosis of anæmia is very much aided by the detection of various murmurs, recognizable by the trained ear of the skilful physician, as the watery blood passes through the heart and larger veins. Thus, for example, over the valves of the heart a bellows-murmur, as it is called, may be detected, and the jugular veins of the neck are often the seat of a well-marked, venous hum in profound anæmia. In all doubtful cases the number of red blood globules in a cubic millimeter ought to be counted under the microscope by the aid of the ingenious apparatus contrived for that purpose.

*Treatment.*—The first effort in the treatment of a case of anæmia must be to find out the cause, and remove that if possible. Whilst this is being done, however, every effort should be made to counteract its evil influence upon the system, by supplying the materials for enriching the blood, and especially those which are necessary to construct the red corpuscles, a deficiency of which appears to be the essential element in this malady. Iron, which enters into their constitution more abundantly than that of any other tissue of the body, is hence obviously called for, and should be administered in whatever form can best be assimilated. Where it is well tolerated, there is probably no better preparation than tincture of the chloride of iron, in twenty-drop doses three times daily, and it often proves beneficial in the highest degree. The chief objection to this excellent form of a chalybeate is, that when not well made, it may blacken or even injure the teeth, although this difficulty can usually be provided against by diluting the medicine in three or four table-spoonfuls of water, and rinsing out the mouth with water, to which a few drops of spirits of hartshorn, or a few grains of baking soda have been added, directly after swallowing the remedy. In cases where the tincture of the chloride of iron is not applicable, or is objected to by the patient, the powdered iron called also iron reduced by hydrogen, in doses of a grain thrice daily, can almost always be borne, and is frequently of the greatest service. All the compounds of iron need, however, to be used for a long time, usually several weeks and often for several months, in order to cure the anæmic condition. They must, besides, be aided by the best food which the stomach can digest, and there is no doubt that the iron which is in beef and mutton, and gives much of its red color to the muscular fibres of the flesh, is in the most favorable state for assimilation into the human system, and often has a large share in the improvement which we are perhaps too ready to attribute to the chemical compounds prescribed. With some practitioners, the citrate of iron or the citrate of iron and quinine, in doses of from three to five grains, are great favorites, and they possess one great advantage over many other preparations

of this useful metal, in the fact that whilst perfectly soluble, they produce upon the organ of taste little of that styptic or ink-like impression which to many persons is so exceedingly disagreeable.

### BERI BERI.

This is a very fatal but obscure disease, occurring in Ceylon, the Malabar coast, and other parts of British India. It commences with the symptoms of anæmia, and proceeds to the development of acute dropsy. It is regarded, next to cholera, as the most fatal disease to which Europeans are liable in India.

### GENERAL DROPSY.

This disease, formerly called with greater correctness *hydropsy*, because it is derived from two Greek words signifying water and an appearance, may be defined as an accumulation of water or serous fluid in one or more of the natural serous cavities of the body, such as that of the peritoneum, which covers almost the whole of the intestinal canal, described on page 145, or a diffusion of fluid through the interstices of the connective tissues, just beneath the skin, which it fills up as water does the pores of a sponge which is dipped into it. Very frequently this excess of water in the connective tissue, especially that of the legs and feet is associated in general dropsy with effusion into one or more of the serous cavities. The accumulation of water in dropsy is sometimes an indirect consequence of inflammation, as is seen in the neighborhood of a common boil, though more usually it occurs independently of the inflammatory process, by simple leakage through the relaxed blood-vessels. Sometimes, again, it is a result of over-distension of the blood-vessels, particularly of the veins and their capillaries, so that it may arise from many different morbid conditions, and hence constitutes a symptom of various diseases. In general terms, it may be stated that when dropsy occurs, there is either some mechanical impediment to the circulation or an altered condition of the blood itself, which alteration may be an excess of water, or a contamination with excrementitious materials. In a majority of cases all these conditions coexist; in other words, there is impeded circulation, perhaps from valvular affection of the heart, of blood which is at the same time rendered poor by an excess of water, and is contaminated with the elements of bile or urine, in consequence of disease or torpor of the liver or the kidneys. It is therefore evident that a case of dropsy will be very apt to present two classes of dangerous symptoms, namely, first, those produced by the original disease, and second, those produced by the effusion of watery fluid.

Among the more important varieties of dropsy may be mentioned



that in which the fluid occupies the cavities or ventricles of the brain, and constitutes a disease called by medical writers hydrocephalus. When the serous fluid is effused into the pleura around the lungs, the term hydrothorax is applied; when it is poured out around the heart, it is designated by the word hydropericardium. If the cavity of the peritoneum or membrane around the intestines is the seat of the collected water, the complaint is named ascites, and so forth. Should the connective tissue of one region only, as of the leg, be filled up with watery fluid, it is usually said to be edematous, whilst anasarca is the epithet applied to a more or less general accumulation of serous liquid in the connective tissue throughout the body. Lastly, the combination of anasarca with dropsy of one or more of the large serous cavities, is known as general dropsy.

In order to comprehend the way in which dropsy usually originates, it must be borne in mind that from all the internal surfaces of a healthy body an excretion or oozing forth of fluid is constantly taking place, and that a corresponding process of absorption is also constantly going on. In consequence of these two antagonistic operations, as long as the two processes are properly proportioned, the surfaces will merely be kept comfortably moist, and the balance of health, as already emphasized on page 10, will in this respect be the result. But if we suppose that the exact compensation is from some cause or other disturbed, and imagine effusion to take place more rapidly, or on the other hand absorption to progress more slowly, from the surfaces of one of these shut sacs, than is proper, it is plain that dropsy will be the result. It is probable that absorption takes place by the lacteals, the lymphatics, and also by the veins; the first of these vessels taking up the chyle from the alimentary canal, the second removing the worn-out particles of the body, and the third imbibing the fluid exhaled from the serous membranes, such as the peritoneum. In dropsy of various kinds, the veins and their capillaries are chiefly at fault. Almost every one is aware that if a string is tied tightly around the finger, or a firm band of any sort fastened around the arm or leg, the part of the body beyond the ligature will swell up, in consequence of the return of the blood through the veins being thus mechanically interfered with. The same effect may be produced by the pressure of a tumor, which interferes with the return-flow of blood through some large vein which drains a considerable part of the body, as for instance the brachial vein of the arm. Such an interference with the reflux current of the blood necessarily causes a congestion of all the blood-vessels involved, and the turgescence prevents the capillaries and veins from taking up any more fluid, as they ought to do, and also produces a tendency to the leakage of the more watery portions of the blood through the turgid vessels. This effusion takes place more freely through the capillaries and small veins, because their walls, being extremely thin, are most easily permeated.

When dropsies arise from defective absorption of serum which has escaped into the tissues in a nearly natural amount, they are called chronic or passive dropsies. When they are produced by an excessive exhalation of serous fluid, the name of active or acute dropsies is applied to them. Dropsies due to disease of the heart, or of the kidneys, slowly produced by alteration of the blood, as well as by mechanical interference with the circulation, are usually of the former kind. Those arising from cold, by sudden checking of the urine and the perspiration, or by the poison of scarlatina, and so forth, belong to the latter variety. The primary causes producing the conditions of disturbance in the system on which dropsy depends, are, firstly, any circumstances which can induce irritation or congestion of the secreting tissues, such as cold, the sudden driving in of eruptions upon the skin, or of the poison of gout or rheumatism, for example; secondly, whatever weakens the tissues or impoverishes the blood, as for instance insufficient food, loss of blood, exhausting diseases, malaria and scurvy; and thirdly, whatever obstructs the circulation of the blood and produces venous congestion, as obliteration of the veins, the pressure of inflammatory products and of tumors, as well as organic diseases of the lungs, heart, kidneys, liver and spleen.

The symptoms of dropsy vary somewhat, according to the primary disturbance which has been the original cause of the effusion. If the blood is deteriorated by an undue proportion of water, or is charged with excrementitious materials, such as urea, which ought to be eliminated by the kidneys in the urine, or contains a large excess of white corpuscles its circulation through the capillary vessels is much impeded, as if its altered composition caused it to slip along inside these hair-like tubes less easily. This impediment is, of course, most felt at the parts most removed from the influence of the propulsive power of the heart, and where the force of gravity in the usual postures of the body is the greatest. Hence it is in these portions that the transudation of serum through the coats of the choked-up vessels first occurs, and the process of absorption being at the same time usually arrested, the dropsy in these cases often begins in the form of œdema about the feet and ankles. If the complaint is not checked in this stage, the œdematous or water-soaked state extends up the knees and thighs. The reproductive organs often become enormously swollen, and ascites or dropsy of the abdomen soon sets in. After a time, the increasing ascites, by pressing up the diaphragm, interferes with the respiration, causing distressing dyspœa, which is more urgent in proportion as the blood is watery from anæmia. The urine is often scanty, and apt to contain an excess of urates, but it is only markedly albuminous when, as frequently happens, the kidneys become secondarily implicated. Among the later symptoms are palpitation of the heart, deficient perspiration, mental distress, thirst, constipation, daily increasing weakness, and so forth.



Disease of the mitral or aortic valves in the heart is the most common cause of cardiac dropsy. The injured valve sooner or later interferes so much with the circulation, as will be explained more fully in our article upon heart-disease, that serious disturbances become manifest. At first, perhaps, there is only shortness of breath on going up a steep flight of stairs, or other active exertion, with some palpitation and debility; but after a few weeks or months the feet and ankles may begin to swell, the skin putting on a peculiar white and glistening appearance. As the effusion extends upwards rest in the recumbent posture becomes impossible, and even in the sitting position only unfreshing snatches of slumber can be obtained. The heart's action grows daily more and more embarrassed, the lungs more or less congested, and a frothy expectoration sometimes streaked with blood appears. By means of auscultation and percussion the physician can usually discover the extent and kind of disturbance effected in the lungs and heart. In advanced stages of general dropsy from cardiac disease the eyeballs often protrude; the sides of the nostril are distended with each effort at respiration, and the urine is scanty, though it does not usually contain albumen until the circulation becomes exceedingly embarrassed. So long as the flow of blood through the liver is not greatly impeded, there is not much dropsy in the cavity of the abdomen as a result of effusion from the peritoneal membrane. Near the close the difficulty of breathing becomes most urgent, and, in fact, death is very apt to occur from apnoea, that is literally want of breath, the drop-sical effusion in the air-cells of the lungs interfering more and more with the natural process of respiration, as described upon page 111, until a sort of death by drowning is the result.

In the variety of general dropsy, which proceeds from disease of the liver, serous effusion into the cavity of the abdomen is the most prominent symptom, as will be explained more in detail in its appropriate place. Whether the original hepatic disorder is congestion or hypertrophy of the liver, cancer, contraction, or chronic hepatic inflammation, the drop-sical symptoms usually commence with exudation of fluid into the abdominal cavity from the surface of its lining membrane, the peritoneum. Dropsy of the feet and legs, however, subsequently sets in. As the ascites increases the symptoms of disorder of the liver, which have shown themselves for some time previously, become more marked and severe. The attacks of sickness, the constipation and unhealthy stools, the sallow and jaundiced skin and conjunctiva or white of the eye, the urine loaded with bile and urates, the restlessness and weakness, as well as the wearying pain, fullness and tenderness on the right side in the hepatic region, which are all results of a greatly impeded flow of blood through the portal vein emptying into the liver, indicate this important organ as the origin of the suffering to which the afflicted patient is subjected.

Acute general dropsy from disease of the kidneys, or acute inflamma-



tory dropsy, may arise when the functions of the skin are suddenly suppressed, thus allowing certain morbid materials to accumulate in the blood, and so set up inflammation in the secreting tubes of the kidneys. Typical examples of this form of dropsy are seen when, from exposure to cold, the action of the skin is checked during the stage of desquamation of scarlet fever, referred to on page 325; compelling the kidneys to remove the scarletinal poison from the system, when it seems to be particularly obnoxious to the renal tissues. In such cases the urine either gradually or all at once becomes scanty, dark brown in color, and on being tested by boiling is found to be loaded with albumen. About the same time general dropsy sets in, and proceeds often with great rapidity. There is more or less effusion of serum into the connective tissue just beneath the skin all over the body, as well as into the serous cavities, such as that of the peritoneum. This may be followed in a few days by complete suppression of the urine, with convulsions, coma and other symptoms of uræmic poisoning. In the large majority of the cases, however, this form of dropsy can be relieved by prompt and active treatment, unless the inflammation in the kidneys is unusually extensive. In cases of chronic disease of the kidneys dropsy is a usual accompaniment, but comes on, as a rule, at a late stage, when the composition of the blood has become altered, and the circulation through the renal organs is seriously obstructed. The effusion into the connective tissue, constituting œdema, is apt to show itself in the loose structure just beneath the eyes, although it is sometimes noticed primarily in the feet and ankles. Towards the close, dropsy of the peritoneum, pleura, and pericardium frequently occurs. Complication with valvular disease of the heart aggravating the tendency to dropsical effusion is not uncommon.

The diagnosis of dropsy is usually made with ease by the fact that the indentation, produced on firm pressure with the finger upon the enlarged part, remains for a minute or so before it is filled up by return of the watery fluid into the connective tissue. This evidence of the existence of dropsy is most conclusively obtained when the test is applied over some bone which naturally lies only a little way beneath the skin, as for example, the breast-bone or the shin-bone. The only other general swelling with which dropsy is liable to be confounded, is that produced by the entrance of air beneath the skin, constituting the disease called emphysema. This latter condition is easily recognised by the crackling sensation felt upon pressure, and the absence of the "pitting" or indentation remaining after the removal of the finger, which has been described as characteristic of dropsy. If there is much anasarca, that is, dropsy of the feet and legs, some peritoneal and pleuritic effusion almost always exists. Should, however, the amount of liquid in the peritoneum, pleura, or pericardium, be proportionately great, there may generally be found some evidences of local disease in the liver, lungs, or heart respectively, in addition to the disturbance causing general dropsy.

The prospect of recovery, or prognosis in dropsy, depends chiefly upon the nature of the primary disease, that is to say, whether the heart, liver, or kidneys, are affected and what is the variety of that primary disorder. Where there is no organic alteration of a vital organ cures can frequently be accomplished. In cases of spontaneous recovery the disappearance of the effusion is often accompanied by abundant sweating, profuse flow of urine, or copious watery diarrhœa. Hence, in the treatment of dropsy, these natural processes should generally be imitated. Even where the heart, kidneys, or liver, are permanently affected the dropsy can often be temporarily relieved, and diminution of suffering as well as prolongation of life secured by the use of appropriate remedies. In fatal cases death may occur from the dropsy itself, or from some intercurrent inflammatory disorder, such as pleurisy or peritonitis, or from the primary organic disease. It must be remembered that in dropsy, due to some fatal disease of the heart or kidneys, the patient may succumb to the effects of the dropsical effusion long before the mortal disease would of itself be the cause of death. Hence, if this distressing symptom can be mitigated, life may be materially prolonged.

*Treatment.*—The objects of the administration of remedies in cases of dropsy are, first, to get rid of the watery effusion; and second, to cure if possible the primary cause of the disease. The former of these indications is to be met by eliminating water from either the bowels, the kidneys, or the skin. Of these avenues for excretion the most efficient is the intestinal canal, and therefore hydragogue cathartics, or those purgatives which produce abundant watery discharges, are very valuable. Among such medicines elaterium in doses of one-eighth of a grain every four hours frequently proves the most prompt and reliable, but is sometimes too prostrating in its effects to be long continued. It is especially useful when effusion into the pleura, or into the lung-substance, causes difficulty of breathing, and may then be employed when the patient is apparently very feeble. In milder cases, ten grains of powdered jalap with a tea-spoonful of cream of tartar every four hours until purgation is produced, frequently answers the purpose. Diuretics are seldom as efficient as cathartics, but sometimes may be preferred where the urgency is not very great. A good combination is made up of two tea-spoonfuls of the infusion of digitalis, with a heaping tea-spoonful of cream of tartar, dissolved in a quarter of a pint of water four times daily, but teas of bruised juniper-berries, or of the tops of broom-corn, made of the strength of one ounce to the pint of boiling water, and the whole quantity drunk in the course of the day, are sometimes beneficial. The least efficient method of obtaining relief from dropsical effusion is by producing profuse sweating, yet this means is occasionally valuable in conjunction with the other treatment. One of the best diaphoretics is the hot-air bath, but sweet spirits of nitre in tea-spoonful doses, Dover's powder in quantities of ten

grains, or jaborandi may be tried. If the limbs become very much swollen, as frequently happens, some benefit may be obtained by pricking the distended skin in a great number of places with a coarse needle, and allowing the fluid to drain away through the little punctures thus produced; scarifying with a lancet, which is more effectual in affording an outlet for the fluid, is objectionable because it is apt to be followed by erysipelas of the incisions. Cracking or ulceration of the skin sometimes gives spontaneous relief, but is apt to leave very intractable sores.

*Diet.*—In general dropsy attention to the diet is very important and efforts should be made to restrict the patient to the smallest amount of fluid with which he can sustain life comfortably. Dry articles of food should be selected, and all substances such as condiments which excite thirst ought to be scrupulously avoided.

The special treatment for the primary disease, of which, in any particular case, general dropsy is the symptom, will be found described under its appropriate head. The reader is therefore advised to consult the articles upon anaemia, diseases of the liver, diseases of the kidneys heart-disease, malaria, and scarlatina, in connection with this subject.

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## CHAPTER VII.

# LOCAL DISEASES AFFECTING THE NERVOUS SYSTEM.

THE local diseases which will be considered in this and several of the succeeding chapters, comprehend all those which affect particular parts or special organs of the body, leading to obvious disturbance of their functions. These diseases are often accompanied by constitutional symptoms, but such symptoms when they succeed to and depend on the existence of the local disease, as, for example, the constitutional symptoms of fever may depend on an inflammation of the eye, must be regarded as secondary. Many local disturbances are, on the contrary, secondary to a general disease, as for instance, the suppuration of the Peyer's glands of the intestines in typhoid fever. The local affection in some of these cases is so striking and important that it especially attracts attention, even whilst the constitutional morbid state, from which it may have sprung, is



yet concealed and unsuspected. Nevertheless, the local trouble is quite secondary to the constitutional one, and can only be properly treated and effectually cured by attention to the general disease. Many of the skin diseases are of this character.

The local diseases, of which a felon on the finger affords an excellent illustration, are characterized by more or less defined local lesions or changes of structure, with specific, morbid phenomena, local symptoms, and physical signs.

The fundamental principle underlying the structure of the nervous system consists in the association of nerve cells or centres with nerve fibres. The former of these, the nerve cells, are found in the grey matter, as it is called from its color, of the brain and spinal cord, and are endowed with the wonderful power of producing the nervous influence or nervous fluid. The nerve fibres, which make up the white matter of brain, spinal cord, and the nerves which radiate from these nerve-centres to every part of the body, are the conductors of the nervous force. They correspond exactly to the individual wires and bundles of wires which go to make up an intricate telegraph system. In regard to the functions of different bundles of the nerve fibres, which constitute the white cords, commonly called nerves, it may be stated that they are entirely independent from end to end, that is, from the tip of the finger to the centre, it may be, of the brain, and therefore capable of carrying a sensation towards the brain, or a motor impulse from it, without any interference with other bundles of nerve fibres in close proximity. But an irritation propagated along one nerve to its root or origin in the brain or spinal cord, may there so affect the nerve-centre in the neighborhood of that root as to cause an excitement of other nerves arising in close proximity to it. This round-about stimulation of a nerve is called reflex action, and the associated movements of the muscles of the pharynx in swallowing, as described on page 143, are good examples of it. The brain alone furnishes the conditions necessary for the intellectual faculties; the spinal-cord motor conditions, or those essential to muscular movement. Together they connect the balancing or co-ordination of motor and sensory power.

### **The Diagnosis of Nervous Diseases.**

The difficult task of diagnosis, or recognition of diseases of the nervous system will be rendered easier by a remembrance of the following facts: The brain may be supposed to be the seat of disease when several of the special senses, such as sight, hearing and speech, are affected at the same time, or when perception, will-power and reasoning capacity are disturbed; or when the nerves, on which muscular movement and general sensibility depend, are affected on one side of the body only, as in one arm and the leg upon the same side; or when muscles as high up as those of the face and tongue are involved, provided the orbicular muscles,

which close and pucker up the eyelids, are not influenced. The spinal cord is presumed to be diseased if the disturbances of motion and sensation occur on both sides of the body at once, whilst the mental faculties are unchanged. The precise seat in the spinal cord may be determined, sometimes with considerable accuracy, by the aid of a knowledge of the anatomy of the spinal nerves, just as a telegraph operator can tell about where on a long line of wires a break has occurred by noticing with which stations his communication is interrupted. If the lesion or disease of the spinal cord is seated high up near the base of the brain, speech, swallowing and respiration may all be impaired. The individual nerve-trunks may be presumed to be the seat of disease when the symptoms are referable to an isolated muscle or group of muscles, or to a small portion of the sensory surface of the body. The diagnostic value of vomiting as a symptom of disease of the brain is very great, and must be constantly borne in mind. Indeed, the intimate sympathy existing between the stomach and the brain is a matter of daily observation. The reverse process is almost equally common in the form of headache from gastric disease, but with this condition of cerebral disturbance disorder of the bowels is usual; whilst in gastric derangement from disease of the brain, constipation is the rule. In children, especially, the occurrence of obstinate but easily accomplished vomiting is indicative of some affection of the head rather than of the stomach. In regard to the action of different parts of the brain, Dr. Ferrier's observations tend to show that the front portions of the hemispheres of the brain, which, as they lie in the under half of the skull, bear a singular resemblance to the kernel of an English walnut resting in the lower half of its shell, are the centres of voluntary motion and of the active, outward manifestations of intelligence; also that certain convolutions, or groups of convolutions, are the centres for the movements of particular organs, such as the eyelids, tongue, ear, neck, hand, foot, and the tail in animals; furthermore, that the action of each hemisphere of the brain is generally crossed, that is, shown upon the opposite side of the body; but that in certain movements of the mouth, tongue and neck, it seems to come from both hemispheres in unison. Hence it follows that in palsy of the right side of the body, the disease inside of the skull is usually situated in some of the convolutions of the left hemisphere of the brain.

The intrinsic diseases of the nervous system may be, moreover, divided into acute and chronic. The former of these can be distinguished from the nervous symptoms, which attend the febrile state of many of the general diseases already described, by the absence of fever as shown by the thermometer. These symptoms may depend upon either diminution or exaggeration of functional activity, apoplexy being an example of the one and convulsions of the other. The same difference is to be noted in the chronic or more prolonged diseases of the nervous system. When a



peripheral nerve, that is, a nerve outside the cavity of the brain or spine, is injured, the muscles to which it is distributed are apt to waste, and in some instances the degeneration seems to be propagated to the root of the nerve in the brain or spinal cord.

Headache is not only the commonest, but often the most distressing, symptom of disorder of the brain. It may be either cranial, so called when it is due to disease of the scalp or of the bones of the cranium, or to inflammation of the ear; or it may be cerebral, arising from inflammation or other organic disease of the brain and its membranes, or produced by some alteration of the quantity or quality of the blood circulated through the brain. In the latter case, it often depends on diseases of remote parts of the system, such as the kidneys. In practice, it is often found very difficult to refer a headache to its precise cause. When the pain is severe, constant, and localized to one spot, disease of the bone or of the membranes beneath is probable. In neuralgia of the scalp the pain is superficial, paroxysmal, associated with tender points, and almost always one-sided, since its distribution corresponds with that of a sensory nerve. Headache from structural diseases of the brain, such as inflammation or tumors, is usually severe, fixed, persistent, aggravated by lying down, and often associated with convulsive or paralytic symptoms.

Delirium is another common symptom of brain-disease, as well as of many general diseases, such as the fevers. It varies from mere incoherence of ideas to the most complete mental derangement, and may be either mild and quiet, busy and garrulous, low and muttering, or wildly maniacal. In judging of its importance as a symptom, it must be remembered that its liability to occurrence, its character, and its intensity, are largely dependent upon the nervous constitution of the patient. Intemperate persons, for example, are liable to attacks resembling delirium tremens, in connection with any kind of febrile disorder. Vertigo is still another symptom of cerebral disturbance, and consists in a peculiar sensation of movement, sometimes attributed by the patient to his own body, and at others to objects around him, and accompanied by a feeling of instability and fear of falling.

Insensibility, stupor and coma, are terms applied to different degrees of functional incapacity of the brain. In the first of these there is loss of consciousness, sensation and voluntary motion, although the automatic and reflex movements, such as the breathing, continue. In stupor, even these latter are much interfered with, and in coma the loss of functional power extends to that part of the brain called the medulla oblongata, in which are situated the centres presiding over the respiration, and pulsation of the heart, and death ensues from their ceasing to act. Stupor and coma may be produced, first, by disturbance of the circulation of the blood in the brain, as in extreme congestion, on the one hand, or profound anæmia, on the other; second, by deficient oxygenation of the blood, as



in asphyxia or death by suffocation; third, by poisoned conditions of the blood, as from an overdose of opium; or fourth, by inflammation or other disease of the cerebral structure, or by injuries to the brain.

The word convulsion is applied to any spasmodic muscular contraction beyond the control of the will. Convulsions may affect a single muscle, a group of muscles, a limb, one-half the body, or the whole of it, and may vary in intensity from the mere trembling of a single muscle to most violent contractions of the whole system. When these contractions are intermittent, they are called clonic, and when persistent, tonic convulsions. The three grades of convulsions which are usually distinguished, are simple tremor, such as is seen in old people, choreic movements met with in St. Vitus' dance, and true convulsion, which occurs, for example, in epileptic fits.

Paralysis or palsy indicates the opposite of spasm, and denotes impairment or loss of motor power. General paralysis is the result of enfeeblement of the brain as in insane persons. Hemiplegia or half-palsy implies a loss of power on one side of the body, generally the arm and leg of the same side, sometimes the same side of the mouth and tongue being implicated. Paraplegia is due to disease of the spinal cord, and is loss of power in the lower half of the body. Hyperæsthesia means excess of sensibility, such as has already been mentioned as a characteristic symptom of cerebro-spinal meningitis, and anæsthesia denotes impairment or loss of sensibility, such as is frequently, but not necessarily, associated with paralysis.

### MENINGITIS OR BRAIN FEVER.

This disease is a local inflammation of the meninges or membranes which enwrap the brain, and, as might at once be supposed, is a very dangerous affection. Although inflammation of the substance of the brain does occur, without the membranes which surround it being involved, such an event is so rare as to require no present notice. Acute simple meningitis is not very common, but may be set up by disease or injury of the bones of the skull, and also appears in connection with certain specific fevers, with erysipelas, profound debility, nervous shock, and in venereal disease. The common form is that caused by the deposit of tubercle, the characteristic material produced in consumption and scrofula. Hence this variety is called tubercular meningitis. It is a lamentably frequent and fatal disease of childhood. Acute, simple meningitis especially affects the convex portion of the hemispheres, it is characterized by congestion of the membranes, and the gradual formation of a firm, yellowish-green exudation, composed of lymph and exudation-cells beneath them.

The symptoms of the simple and tubercular acute meningitis may be

considered together. In tubercular meningitis there are usually premonitory symptoms, such as headache, irritability, fretfulness, constipation, with loss of appetite and of strength. The actual invasion of the disease is sometimes marked by shivering, followed by fever and intense headache, at others by obstinate vomiting, a strange, wild manner, or by an attack of convulsions. After the disease is established, its course is usually marked by three stages. In the first, that of irritation, there is decided fever, often of a very irregular type, a frequent pulse, subject to many variations independently of the fever, irregular and moaning breathing, nausea and obstinate vomiting, with great thirst, loss of appetite, and constipation. The headache is constant, and often so severe that the patient shrieks with the pain, supporting and pressing his head with his hands. This headache may be associated with tenderness of the scalp and radiating pains through the limbs. The sufferer is peculiarly irritable, peevish, and restless, and towards night active delirium is apt to come on. Not infrequently tremor or twitching of the face and limbs, squinting with contracted pupils and general convulsions, or tonic muscular contractions are noticed. There may also be general hyperæsthesia with intolerance of light and sound. In the stage of transition, which constitutes the second period, the headache and other marked symptoms of the first stage subside, and the patient becomes for the most part quiet and drowsy. The temperature generally falls, sometimes to the natural standard or even below it. The pulse is slow and irregular, and the respiration also unequal and sighing. The patient is dull and apathetic, taking food only when offered, and then often with difficulty. He rolls his head from side to side uneasily, and often picks at the bed-clothes. The pupils are dilated, quiet delirium is usual, and paralysis may come on. In the third stage, that of coma, the great characteristics are the deep stupor and convulsions. Absolute insensibility prevails, and the patient can no longer be roused. The pulse again becomes rapid, but is very feeble. The breathing is also frequent and irregular. The temperature varies greatly, in some cases rising rapidly as death approaches, and in others falling below the natural degree. The tongue is brown and coated, and the lips and teeth covered with sordes. Convulsions occur more and more frequently, and often attend the closing scene of this disease, which is almost always fatal in from one to three weeks. It must be borne in mind that in practice, various departures from the above general course of this terrible disease are met with; that the division into stages is not always well marked; that even when they are well defined, the passage from one to another is, as a rule, gradual, and that their absolute and relative duration may vary very much.

The diagnosis of acute meningitis must be made from typhoid fever, which it may somewhat resemble in the early stage, and this is sometimes difficult until the occurrence of an attack of convulsions, or of the

squinting already mentioned, is almost conclusive evidence of the presence of inflammation of the brain-membranes. Ordinarily, the absence of diarrhœa or pain in the abdomen and the obstinate yet easy vomiting prevent error. Sometimes, in children very much exhausted by cholera infantum, stupor with irregularity of the pulse and respiration are observed, and might lead to mistaking the intestinal affection for tubercular meningitis. But the history of the case, the absence of high fever, of intense headache and intolerance of light are generally sufficient to enable an attentive observer to avoid error. In the rare cases, where the symptoms of brain-disease are simulated by those caused by worms in the bowels, an active vermifuge will settle the question.

*Treatment.*—The treatment of acute simple meningitis must be active from the beginning, and bleeding, or, in children, leeching, followed by energetic purgation with ten grains of calomel should be practiced. The head ought to be shaved, and ice applied by means of bags or bladders, as continuously as can be done without producing symptoms of depression, and calomel in grain doses every hour or two, carried to the point of producing salivation, should be administered. Iodide of potassium, in doses of from five to ten grains thrice daily, is also strongly recommended. Notwithstanding our best efforts, the large majority of all the cases of acute simple meningitis prove speedily fatal, whilst a few gradually run into the chronic form, from which recovery is almost equally hopeless, although the patient may linger with impaired mental and physical powers for months or years, a burden to his friends, and a constant, perhaps agonized, sufferer. In tubercular meningitis there is almost no chance of recovery, and some physicians contend that in those few instances where the patients are reported to have got well, the diagnosis of the disease was always incorrect. Bromides in twenty-grain doses every four hours, and morphia to relieve the intense headache and the distressing restlessness therefore constitute the chief part of the treatment, although iodide of potassium is recommended. After the first development of the symptoms of depression which characterize the second stage, there is often a marked though delusive appearance of improvement in the patient's condition, which may mislead the attendants into entertaining a false hope of immediate recovery.

With this gloomy prospect it is, of course, of tenfold importance that the onset of this mortal form of tubercular disease should be guarded against by every means in our power, as has been pointed out in the chapter on hereditary tendency on page 49.



### SOFTENING OF THE BRAIN.

Softening of the substance of the brain occurs in two forms, called respectively red and white softening. In more than one half the cases, all premonitory symptoms, such as headache, dizziness, and temporary numbness of various parts, are absent. The attack may be either sudden or gradual, in the former instance resembling a stroke of apoplexy, whilst in the latter the symptoms of dullness and drowsiness gradually deepen into coma. Transient excitement or mild delirium may precede the loss of consciousness, and when this occurs it is highly characteristic of red softening of the brain tissue. The diagnosis of softening is confessedly difficult, but the following combinations of symptoms are most likely to be connected with it: First, imperfect coma with partial loss of perception and volition in conjunction with rigidity of the limbs; second, perfect coma without rigidity; third, paralysis without loss of consciousness; fourth, paralysis with hyperæsthesia; fifth, rigidity coming on after the return of perception and volition. The after symptoms of softening are also strikingly different from those of apoplexy. The morbid phenomena do not suddenly disappear, nor is there the gradual improvement which takes place after apoplexy. Enfeeblement of the mental faculties commonly persists, as do the changes in the powers of muscular movement. Slight apoplectic-like seizures occur, convulsive movements and rigidity increase, and some little febrile excitement becomes developed, which in severe cases generally assumes a typhoid type, with brown tongue and rapid pulse. From such a condition recovery is rare, and the softening, which it indicates, is more frequently an acute than a chronic disease, the greater number dying before the twelfth day. Where the diffuse inflammation of the brain, which threatens softening, is due to any mechanical injury, bleeding, either general from the arm, or local by cupping or leeching the back of the neck and behind the ears, is advisable; but after softening actually commences little can be expected from any remedial measures. Absolute rest and quiet in a recumbent position, but with the head high, are important, and nourishing food, as soon as the acute symptoms, if any appear at first, have subsided, with tonics should be allowed. The bowels should be opened freely by means of an injection of castor-oil and turpentine, or if the patient can swallow, a purgative of calomel and compound extract of colocynth, with or without croton-oil, ought to be administered. The feet may be bathed in hot mustard water, and then kept very warm by hot-water bags or bottles, and the use of mustard poultices to the ankles. In the meantime if the head is warmer than natural, and any indications of congestion are obvious, cloths wrung out of ice-water or cold vinegar and water may be applied to it, or bladders of ice cautiously employed.

Yellow softening of the brain is probably less common than red soft-

ening, and is due in most instances to the obstruction of some small artery cutting off the blood-supply to the minute, often wedge-shaped, portion of brain tissue, which it had previously nourished. Its onset is frequently sudden, like that of a stroke of apoplexy, and it may prove fatal in a day or two, life being rarely prolonged for more than a week. Yellow softening is not so much a disease in itself as the result of various disease-processes, which may run along for a considerable time in the substance of the brain, without giving rise to any obvious symptoms. Little or no medical treatment is admissible, and good care and nursing, including the administration of nutritious food, offer the best means of benefiting the sufferer.

Abscess of the brain is a rare disease, fortunately, since it is one which is very apt to prove fatal. The most common cause is the inflammation of the ear, which occurs in scarlet fever, and occasionally in typhus fever, small-pox, and scrofula. The pus or corruption is sometimes found collected together in a sort of pocket, like that of a common boil, or it may be infiltrated into the soft, spongy substance of the brain. The symptoms are often very obscure, but sudden headache is the one which most often excites attention, and it is generally accompanied with fever and vomiting. Coma occurs frequently, but may be only temporary, and paralysis appears in about one-half the cases. The only treatment likely to be useful is of the palliative kind recommended in meningitis.

### APOPLEXY.

This common and much dreaded disease is one characterized by the abrupt loss of will-power, perception, sensation and motion, and is dependent upon sudden pressure upon the brain, the tissue of which may be diseased from some cause originating within the cavity of the skull. The symptoms are very similar to those brought on by a blow upon the head denting in the skull so that the bone presses upon the brain, and they are produced in exactly the same way, except that instead of the broken bone it is often a clot of blood which compresses the sensitive brain structure. The literal meaning of the word apoplexy conveys the idea of a sudden stroke, and it was formerly customary to limit this term to the class of cases where there was a rapid effusion of blood into the nervous tissue which was ultimately destroyed by the resulting pressure. It is now used to designate a group of symptoms which do not always owe their origin to the extravasation of blood. These symptoms consist of, first, premonitory warnings extending over various periods, from a few seconds to several years, and marked by sundry derangements of the nervous functions, such as loss of memory, dullness of sensation, or diminished muscular power; second, the individual is more or less suddenly deprived of volition and perception in their relation to sensation and motion. Con-



sciousness is thus, in part at least, lost, and paralysis is more or less complete. The patient may fall to the ground completely insensible, or he may only stagger and cling to some neighboring object for support. In some of the slighter attacks the respiration may be unaffected, or in severe cases inspiration becomes snoring and expiration labored. Some group of muscles, a side of the body, or the whole body, may be paralyzed, relaxed, and motionless, or it may be rigid with tonic, or convulsed with clonic spasms. From this state, in a certain proportion of cases, the patient never recovers, life being gradually extinguished, or the sufferer may be restored partially or entirely. In the former instance some mental faculty, power of movement, or of sense, may remain impaired for weeks, or for the whole after life. The essential character of the apoplectic seizure consists in the separation, temporary or permanent, of will-power and perception from motion and sensation. The other symptoms are additional manifestations, depending upon secondary changes, subsequently induced in the part of the brain, or in its vicinity, which has been the primary seat of alteration. The phenomena of the apoplectic state are due therefore to a variety of local changes or lesions, or to complex, morbid conditions, and not to any single alteration of the brain substance. Among the most important of the simple and the complex causes, are, first, functional disturbance of the brain, spasm of the blood-vessels, or determination of blood to the head; this form is called congestive apoplexy: second, hemorrhage, that is to say, extravasation, or the pouring out of blood from the broken blood-vessels into the substance of the brain, or into some of its cavities; this constitutes apoplexy, in the usual acceptation of the term, and is denominated sanguinous apoplexy; third, sudden serous effusion in large quantity, which might be called an acute dropsy of the brain, is equally efficient in bringing on the apoplectic state, and goes by the name of serous apoplexy. Local inflammation, tumors, and abscesses of the brain, and under certain circumstances, anæmia may much less frequently bring on apoplectic symptoms. The obstruction of an artery by a clot or plug of fibrin, separated from the blood, may also produce a condition resembling apoplexy, and described on a subsequent page under the name of Embolism.

Actual rupture of a blood-vessel, giving rise to hemorrhage, into or upon the brain, may be due to gradually developed disease of the walls of the arteries within the skull, by which they are rendered weaker, or to increased pressure upon the blood-vessels, such as occurs in chronic Bright's disease, or during some over-strain or prolonged effort, or lastly to any softening of the surrounding portions of the brain by which these blood-vessels are deprived of their usual support. This form of apoplexy, which is by far the most common, is a disease of advanced life, and more common in men than in women. Premonitory symptoms are not usual, but, when present, consist of headache, giddiness, slight hesitation of



speech, forgetfulness of words, ringing in the ears, numbness, tingling and weakness of the limbs on one side of the body, and so forth. The actual onset of the "stroke" is characterized by coma, the patient falls more or less suddenly, and for the time all consciousness, motion, and sensation are lost; the pulse is slow but full, the breathing is slow, labored and snoring, the cheeks are puffed out at each expiration, the face is usually flushed, and the carotid arteries in the neck often throb violently, the eyelids are closed, the eyes, and sometimes the whole head, are turned to the side opposite to the paralyzed one, and the pupils are unequal or contracted. In bad cases even the sphincters are paralyzed, so that the contents of the bowels and of the bladder are evacuated spontaneously. Sometimes patients never become conscious again, and deep coma comes on, in which death takes place, but more frequently after some hours consciousness gradually returns, but hemiplegia or one-sided palsy, with or without aphasia or the loss of the power of connected speech remains and persists for a long time, or perhaps for life; or, again, partial recovery may occur, but owing to a fresh hemorrhage coma returns and proves fatal. Among important secondary manifestations may be mentioned that sometimes a local inflammation of the brain, around the clot of blood which has been poured out, is set up toward the end of the first week, in which case febrile symptoms attended with headache, mental confusion, or even delirium, a tendency to coma, and occasionally convulsive movements, may be observed. These symptoms usually continue for four or five days and then pass off, though they may lead to a fatal result. Again, a permanent change of manner, with loss of memory and perversion of the emotions, is liable to occur after an apoplectic stroke of this kind. Bed-sores sometimes form on the paralyzed side before the fourth day, and in such case are very unfavorable indications. The prospect of recovery from a fit of apoplexy depends upon the severity of the symptoms, and the seat and extent of the hemorrhage. Cases in which complete insensibility persists for more than twelve hours are almost always fatal.

The diagnosis of an apoplectic stroke must be made from the coma of congestive apoplexy, of uræmia, of profound intoxication, and of sun-stroke. The most important sign in all these is the absence of one-sided palsy or hemiplegia, which is rarely found except in genuine apoplexy. Moreover, in congestive apoplexy there will generally be the history of premonitory symptoms, in uræmia the albuminous condition of the urine, in intoxication the alcoholic odor of the breath, and in sun-stroke the great heat of the skin, as corroborative indications.

*Treatment.*—The treatment of apoplexy from cerebral hemorrhage was formerly to bleed freely in all cases, and it is probable that at the present time many lives are lost for want of venesection. If, as is apt to be the case, the patient is robust, of full habit of body, and the pulse is strong, full and slow, the drawing of a pint of blood from the arm will add to

his chance of recovery, and should the pulse be rather weak, leeches or cut-cups to the back of the neck generally prove useful. At the same time the bowels should be opened by an active, purgative injection, or by a dose of ten grains of calomel and five grains of compound extract of colocynth, if the patient can swallow. Should both these means fail, a drop of croton-oil mixed with some sweet-oil may be placed upon the tongue, whence it is generally carried into the stomach with the saliva, and operates energetically upon the bowels. The feet may be placed in a hot mustard foot-bath, mustard-plasters applied to the arms and legs, the head kept cool with cloths wrung out of ice-water, and every obstruction to the free return of blood from the head, in the way of tight collars or other clothing, promptly removed.

After an attack of apoplexy there is always great danger of a recurrence, which, however, is not certain to come on. The subject of a first stroke ought, nevertheless, to live a very prudent life, avoiding all overloading of the stomach, constipation, violent muscular exertion, excitement of the intellectual powers or of the emotions, and intemperance. See article on paralysis.

### SUN-STROKE.

This is a disease occurring in persons exposed to excessive heat and characterized by vertigo, sometimes with violent pain in the head, gradual increase of listlessness and torpidity, and a desire to lie down. The feverish symptoms may culminate in more or less sudden and complete insensibility, without any power of sense or motion, the breathing growing rapid, and becoming more and more noisy as death approaches. Often convulsions of the limbs usher in a state of complete coma, during which the patient expires. The approach of death is indicated by failure of the heart's action, fluttering of the pulse, and irregularity of the respiration, and the fatal event may arrive within from five minutes to a few hours after the disease becomes fully developed. The characteristic symptom of sun-stroke is the high heat of the body, and temperatures of from 109° to 113°, the former ending in recovery, are recorded. The indications of apoplexy, intoxication, and so forth, have already been mentioned on a previous page.

*Treatment.*—The most obvious demand in regard to treatment is to abstract the excessive heat from the body as rapidly as possible, and this can be most speedily accomplished by cold sponging, rubbing the head, neck, and chest with ice, or by the cold pack. Light should be excluded from the patient as far as possible, and if the pulse is feeble, stimulants should be given by the mouth or by injection. If prompt improvement does not occur the hair should be cut short, and a blister applied to the nape of the neck, and this blistering, which often proves highly beneficial,

may be repeated at the end of twelve hours if relapse, as is not very unusual, should come on. Bleeding, or even leeching, is not, as a rule, well borne.

In heat exhaustion the patient is generally found with a cool skin, a feeble pulse, and pallid face, without disturbance of the intellect. In such a condition stimulants, dry heat of hot-water bags or bottles, mustard-plasters to the stomach, and perfect rest and quiet, are indicated.

### **HYPERTROPHY AND ATROPHY OF THE BRAIN.**

Hypertrophy means an actual enlargement or overgrowth of the brain structure generally, whilst atrophy signifies a general wasting of the substance of the brain. As common diseases produced by the ordinary physical causes they are both fortunately rare, though it is possible that as results of excessive, or, on the other hand, insufficient use of the intellectual powers they are not so very uncommon.

The brain is sometimes the seat of morbid growths, including cancers, fibroid, and bony tumors, tubercular deposit in large masses, and cysts containing parasites. All these affections are, fortunately, very seldom met with.

The substance and coverings of the spinal cord, or spinal marrow, being continuations of the brain and its membranes, are subject to similar diseases, described in medical works under the names of spinal congestion and inflammation, spinal atrophy, spinal hemorrhage, and spinal degenerative changes of structure. On account of their obscurity and comparative rarity as independent affections, their further discussion may be omitted here.

The cerebro-spinal nerves, issuing from the brain and spinal cord, and distributed all over the body, are subject to diseases similar to those of the great nervous centres. Thus they may be the seats of inflammation, or, as it is often called, neuritis, or of atrophy, or sometimes fibrous tumors develop in their substances and are productive of agonizing suffering. The treatment in such cases is, of course, to cut out the tumor and affected portion of the nerve, with as little delay as possible, whenever it can be accomplished.

### **PARALYSIS OR PALSY.**

These two synonymous terms are usually applied to an affection in which voluntary motion is lost, the name *anæsthesia* being given to a palsy of the nerves of sensation. Palsy is one of the most common and most distressing misfortunes from which mankind is obliged to suffer, yet its various forms, as already intimated, are rather symptoms of deep-seated disease than diseases themselves. Thus palsy of a limb is very



frequently a symptom of structural disease of the brain or spinal cord, but it occasionally occurs from a diseased state of the nerve-trunk itself. It may affect a whole limb or only part of one, and is sometimes limited to a group of muscles in a particular region. Palsy of a foot, a hand, an arm or a leg, is an example of the first, whilst palsy of the muscles of expression in the countenance, from disease connected with one or both of the seventh pair, which are the facial nerves, illustrates the second. The following conditions give rise to paralysis of motion: First, disease or injury to a nerve in some part of its course, destroying its power of transmitting that force, which is expressed by a contraction of the muscle to which the nerve is distributed; this is exactly analogous in its effect to the cutting of a telegraph wire between the central office and a sub-station; second, a disease of some portion of those central parts of the nervous system, whence the nerve takes its origin, or with which it may be connected directly or indirectly.

Also whatever interferes materially, though temporarily, with the conducting power of the nerve-fibre, or the generating power of the nerve-cell from which it originates, will constitute a paralyzing lesion or disease. The poisons of ether, chloroform, opium, lead, mercury have these effects and those produced under certain circumstances in the system, such as urea, the bile elements, and those of gout, rheumatism and syphilis, may operate in the same way.

There are many different varieties of palsy, among the most important of which are the following:

HEMIPLEGIA or half-palsy is a paralysis in which one lateral half or side of the body is stricken with powerlessness so accurately that it is customary to define the condition by the terms right and left, designating them, respectively, right hemiplegia and left hemiplegia, according to the side of the person which is attacked. This, as already intimated, is the form of palsy to which the name of apoplectic stroke is usually applied, incorrectly, however, because it is only a symptom of the real stroke which the brain has received from the pressure of a clot of blood perhaps, which has been poured upon it. Or, in other cases, it is the symptom of the cutting-off of the supply of blood to a portion of the brain by some little plug of fibrin called an embolus or thrombus, as will be hereafter explained. In the ordinary form of hemiplegia, the arm, leg, lower part of the face, and tongue on the same side, are paralyzed, and this loss of motor-power is on the opposite side to that on which the blood-clot or fibrous plug has formed inside the brain. In severe cases, the arm and leg may be equally motionless, but if there is any difference between them, the leg is generally the limb less affected, the last to be attacked, and the first to recover some of its powers. The angle of the mouth is drawn upward and to the sound side, because the muscles on the affected half no longer antagonize the corresponding ones, as in

health. The face is expressionless, and there is difficulty in wrinkling the forehead, as in frowning, or in pursing up the lips, as in whistling. The tongue, when protruded, diverges toward the paralyzed side, because pushed over by the stronger muscles of the unaffected half. Partly owing to this fact, and partly in consequence of weakness of the tongue and lips, utterance is often defective; but this must not be confounded with the aphasia or palsy of intellectual speech, already referred to. If the clot, or obstructive, fibrinous plug is found lower down, there may be paralysis of the arm and leg upon one side, and of part of the face on the other, constituting crossed hemiplegia. Should the lesion in the brain be seated still lower, partial paralysis of both sides may appear, and this, although seemingly less severe, is the most dangerous of the three varieties, on account of the proximity of the brain lesion to the centres which preside over circulation and respiration. True hemiplegia must not be mistaken for functional hemiplegia, which occurs from hysteria or "hysterics," and also occasionally from the irritation of worms in the alimentary canal.

*Treatment.*—The treatment of hemiplegia at its first onset is subordinate to that of the morbid condition in the brain, which causes it and has already been described. When dependent, as is often the case, upon a clot of blood which has been effused into the substance of the brain, the only rational mode of treatment would be by promoting the absorption of this effused blood, and the repair of the nerve-cells and fibres which have been injured by its presence and the pressure it exerts. The remedies formerly employed for this purpose included iodine, mercury, and local counter-irritation; but we have no evidence that any benefit is thus secured, and this mode of treatment has fallen into disuse. There is little doubt, however, that the removal of the clot may be hastened by whatever improves the general health of a patient, and hence tonics, such as quinine in two-grain doses thrice daily, good, nutritious food, passive movements of the paralyzed parts, gentle exercise in the open air, and change of scene with cheerful companionship, are to be highly recommended. After all danger of renewing irritation about the edges of a mass of clotted blood in the brain have passed away, that is to say, after an interval of two or three months has elapsed since the stroke, nuxvomica or its active principle, strychnia, in quantities of one-sixteenth of a grain three times daily, may often be administered with advantage; but serious injury has sometimes appeared to follow a too-hasty resort to this powerful drug. It seems reasonable to suppose, that in order to prevent the palsied limbs from becoming stiff and wasted by simple want of use, a substitution of the electro-magnetic or galvanic current, for the nervous fluid which is cut off from them, at least temporarily, might be productive of benefit—this being effected by keeping them in good condition and ready for service as soon as the natural stimulus of the



nervous influence is renewed. Experience has proved that this supposition is correct, and marked advantage in regaining, as far as possible, the use of palsied limbs has often been obtained by the persevering application of the interrupted current of electricity, combined with passive motion and systematic exercise of the imperfect movements which the will-power can still control.

PARAPLEGIA is that form of palsy in which one-half the body below the chest, and including the lower limbs, is stricken with the disease. When the spinal cord is affected throughout its whole thickness, both sensation and motion are entirely lost below the seat of disturbance, and a most distressing part of the condition is, that since the nerve-centres controlling the evacuation of the bowels and bladder lie in the lower part of the cord, opposite the loins, the patient generally suffers from constipation and either retention or incontinence of urine. Cases which at first are troubled with retention, so that the renal secretion must be drawn off from the bladder with a tube or catheter, often suffer after a time from incontinence and constant dribbling away of the urine, which, by its irritating quality, promotes the development of the terrible bed-sores which are very apt to form unless the greatest care is exercised. In fact, one of the most important duties of a nurse in attendance upon a paralytic, and especially upon a paraplegic patient, is to guard by all the means mentioned in our article upon typhoid fever, and upon nursing, in a later chapter, against the production of bed-sores—those dangerous, and often fatal, complications of palsy.

LOCOMOTOR ATAXY is another form of palsy, resulting from a disease called sclerosis or hardening of certain motor-centres in the brain and spinal cord. It is indicated by irregular power of locomotion. In it the movements of the body are not correctly under the control of the will, and there is a curious inability to walk forward without falling when the eyes are closed. This is a newly-discovered form of paralysis, not often met with, and, so far, the treatment pursued has been generally unavailing.

PROGRESSIVE MUSCULAR ATROPHY is still another uncommon and incurable form of paralysis, due to a gradual decay and wasting of the muscles, but commencing sometimes with an apparent enlargement or hypertrophy of these organs.

INFANTILE PARALYSIS is a variety of palsy developed in very young children, and occasionally present from the time of birth. As a rule, this palsy arises from disease of the spinal cord and its membranes. It comes on with acute symptoms of fever and convulsions, ending in paralysis of one or more limbs. In some cases the child gradually recovers from the effects of the malady, but in many the impairment is permanent, and the limb, ceasing to develop in proportion to the rest of the body, appears in the adult as if shrunk and withered, constituting a lamentable and



hopeless deformity. The primary disease is so rarely recognized until after the paralysis manifests itself, just as convalescence is apparently established, that proper treatment can seldom be applied. Much can be done towards preventing complete loss of power, by persevering and systematic, passive movements, application of galvanism, and exercise, as suggested in the article on hemiplegia.

LOCAL PARALYSIS is palsy of some special part or organ of the body, generally from disease of the nerve-trunks, the brain and spinal marrow being unaffected, at least at first. The most important varieties of these very numerous kinds are, first, facial paralysis or Bell's palsy. This is sometimes the effect of disease of the middle ear, but more commonly results from cold, especially draughts of cold air striking on the side of the face. One half of the face only is, as a rule, affected, and the muscles on that side are motionless and relaxed. As a consequence the eye cannot be closed, the tears dribble over the cheek, the mouth is drawn to the opposite side, and on that which is affected food lodges between the cheek and teeth. The inability to close the eye generally distinguishes this local paralysis from hemiplegia, as far as the face is concerned. Trivial as it seems, it is of very grave importance, as the absence of the proper moistening of the front of the eye usually leads in a few weeks to blindness. As a rule, this affection is unattended, however, with danger to life.

*Treatment.*—The treatment should consist of leeching behind the ear, followed by repeated blisters to the nape of the neck, with the use of iodide of potassium in five or ten grain doses thrice daily, and in obstinate cases of mercury, in the form of a grain of calomel every four hours, internally. The interrupted galvanic current should be daily used upon the facial muscles, and the eye will be in part protected by mechanically closing the lids with adhesive plaster.

Paralysis of the various spinal nerves, may occur from injury, pressure, or inflammatory disease. One of the most common is, perhaps, palsy of the musculo-spiral nerve on the outer part of the arm, between the shoulder and elbow, which is not infrequently brought on by sleeping upon the arm thrown over the back of a chair. It may sometimes resemble lead palsy, but differs from the effects of the metallic poison in being accompanied by some numbness or loss of sensation. In paralysis of this kind from temporary pressure, friction, passive motion, and electro magnetism or galvanism, will generally affect a cure.

SCRIVENER'S PALSY, or writer's cramp, is a curious form of local paralysis, the result of long continued and unnatural excitement of the nerves controlling the fingers and hand in writing. The earliest indication is a painful sense of fatigue and weakness, which comes on shortly after commencing to write. Sooner or later this begins to be accompanied by involuntary spasms of the muscles employed in holding the pen, and the handwriting grows unsteady, scrawly, and almost illegible. At first these

spasms and irregular movements can be more or less controlled by voluntary effort, but they gradually become worse and worse, until at last the use of the pen is an impossibility. Patients then often learn to write with the other hand, only to find that after a while this becomes affected in a similar manner. Different muscles are involved in different cases, sometimes only those of the hand and fore-arm being concerned, whilst at others the disease extends from one part to another, until the whole arm is affected. Sensation is not disturbed, and for all actions, except that of holding the pen, which first induced the disorder, the muscles behave properly. Rest from writing, tonics, and electricity, accomplish a cure in some instances, but the prospect of recovery is small, and it is therefore very important to avoid the disease by moderation in writing, or by the use of the ingenious type-writer, by the aid of which most of these pages have been prepared.

Diphtheritic paralysis has been already considered, and lead palsy will be discussed in a future chapter.

### TETANUS OR LOCK-JAW.

This is one of the most formidable diseases of the nervous system, and is also agonizingly painful. In it all the muscles of the body may be thrown into a state of firm contraction. The spasm is so extreme that in the worst cases of the malady the muscles may be torn across by their own violence. Sometimes the convulsive contractions become intermittent in certain groups of muscles, whilst persisting continuously in others. The latter is especially apt to be the condition of the muscles that close the jaw, which are very powerful, and hold the mouth shut so firmly that it requires great force to pry it open.

The three forms of tetanus are, first, the traumatic, or that which arises from a wound or injury, and appears particularly apt to come on after a ragged wound of the ball of the great toe, such as is often inflicted by stepping on a rusty nail; second, the idiopathic, occurring without any known cause, but apparently in some way connected with the results of exposure to cold; third, the venenous, or that which proceeds from the action of certain poisons, particularly strychnia, which, of all noxious agents, produces the most frightful tetanic spasms. The traumatic form may arise after any kind of an injury, from the scratch of a pin to a compound fracture. The interval from the reception of the wound to the first tetanic symptoms varies from four to fourteen days, rarely exceeding three weeks at the furthest. The more rapidly it comes on, the more assuredly fatal will generally be the result. The first obvious symptoms are usually feelings of uneasiness about the neck, a sense of constriction around the throat, and stiffness of the jaws. This, which at the beginning may appear like a simple attack of stiff neck, soon extends; diffi-

culty of swallowing appears, and a sense of contraction, increasing to acute pain and even agony, is felt at the lower end of the breast-bone. The latter symptom, which is almost peculiar to tetanus, is believed to be produced by spasm of the diaphragm, and often causes the worst suffering of the malady. As other muscles become involved in the disease, the patient may be bent forward, backward, or to either side, without any power to straighten himself, the pain being similar to, though vastly more intense than, that of ordinary cramp. The contracted muscles seem as hard as wood during a paroxysm, and these fits of more violent contraction may succeed each other at intervals of from a few minutes to several hours. The slightest motion, even an attempt to open the mouth, sometimes brings on an attack. The tongue is, as a rule, clean and moist, the bowels constipated, and the intellect unaffected. In examples of tetanus depending on a suppurating wound, the sore generally dries up and becomes painful, whilst the neighboring muscles are rendered highly irritable. The fatality of this disease is very great. Sometimes death ensues in twenty-four hours, more commonly it occurs on the second, third, or fourth day, and if a patient survive until after the seventeenth day, he generally recovers. Death takes place from spasm of the respiratory muscles, from spasm of the heart, or from exhaustion. Tetanus of newborn infants, called also trismus nascentium, is almost always fatal.

*Treatment.*—This consists of the use of large doses of from half a grain to a grain of morphia, hypodermically, to relieve pain, and the administration of bromide of potassium in twenty-grain doses, chloral in quantities of fifteen grains every four hours, and chloroform or ether to control the paroxysms of spasm. Woorara, or curare, the Indian arrow-poison; Indian hemp in doses of a grain every hour, aconite and belladonna, in quantities of one-fourth of a grain, have also been recommended, and cases of successful treatment by the application of ice to the spine, are on record.

*Nursing.*—In nursing a patient suffering from tetanus, the greatest possible care must be exerted to avoid any jar of the bed or of the room, any blast of cold or even cool air, and any mental or emotional excitement, lest additional paroxysms of the spasms be thereby brought on, and contribute to still more rapidly wear out the fast-failing strength. Should any open wound or sore require dressing during the height of the disease, this should always be accomplished whilst the sufferer is under the influence of chloroform or ether. If, as occasionally happens, the patient is utterly unable to swallow food, the strength must be supported by nutritious and stimulating injections, as has been already suggested in the article upon typhoid fever.



### HYDROPHOBIA.

This is a disease peculiar to animals of the canine and feline races, the specific poison of which being implanted by them in man or other animals, produces the same malady. As a rule, the affection is communicated by the bite of the rabid animal, the poison being contained in its saliva, and the wound made in the person bitten being the receiving surface, but in some instances it seems to have been conveyed through a thin portion of the skin without any wound. The period of incubation of the poison of hydrophobia varies in man from four to sixteen weeks, and even longer. The onset is characterized by constriction about the throat, spasmodic action of the diaphragm, and distress at the pit of the stomach, all of which are aggravated or excited by attempts to drink water, or even by the thought of trying to swallow any fluid. When the disease is fully developed, the same distressing symptoms are excited by the least breath or current of air striking the surface of the body, which produces an effect similar to that aroused by stepping into a cold bath. From the mouth issues tenacious and slimy saliva which the patient spits in every direction. Paroxysms of frenzy and of uncontrollable impulsive violence, during which the sufferer often attempts to bite those around him, come on, and the patient may die suddenly in violent convulsions, or sink exhausted. The duration of the disease varies from three to seven days, but the majority of the cases terminate on the third or fourth day. Death is often sudden and unexpected at the moment. The shortest period authentically reported as intervening between the bite and the appearance of hydrophobia, is stated at fifteen days, and the longest nine months. Instances where it is affirmed that more than a year has elapsed from the date of the bite are not free from suspicion of a subsequent infection, so that a person who has been bitten for over a year without experiencing any symptoms of hydrophobia, may feel comparatively safe. In regard to the percentage of those bitten by mad dogs who become mad authorities differ very widely. Thus Dr. Hammond states that not more than one in fifteen are affected, whilst it is related that out of a series of one hundred and fifty-three persons bitten, ninety-four had hydrophobia, or more than three out of five. The liability seems to vary a good deal, according to the part being covered or not. Thus wounds inflicted by mad dogs on the face, neck, or hands, are much more likely to be followed by hydrophobia than those inflicted upon the legs or feet, where the virus is rubbed off by the clothing before the mad dog's teeth reach the flesh. The bite of a rabid wolf is more apt to be followed by hydrophobia than that of a dog, because the former animal generally seizes the throat or face. Probably the most dangerous wounds of this kind are those which barely penetrate the epidermis, and in which, therefore, the venom is not washed away by any active flow of blood. Mr. Youatt contended that it

was impossible for the saliva of a rabid animal to affect the human subject if it came in contact with the unbroken skin only, as he himself many times had his hands covered with the diseased secretion. He admitted, however, that it might affect man if brought in contact with the mucous membrane of the lips, and it is recorded that a man who untied with his teeth a knot in the cord which had been used to secure a mad dog, and a woman who had pressed with her teeth a rent in her dress, which had been sewed, the said rent having been torn by the teeth of a rabid dog, were respectively affected with hydrophobia, both cases terminating fatally.

*Treatment.*—The great prophylactic measure after being bitten by a mad dog or other rabid animal, is, of course, cutting out the injured part, but this must be done almost immediately after the wound is inflicted in order to be useful. The operation should not be performed with a nig-gardly hand, every part with which the teeth have come in contact being removed, as well as the tissue into which the poison may have become infiltrated. Previous to the excision, in fact, the instant after the wound has been received if possible, a tight ligature should be bound around the limb immediately above the injury, and when the knife has done its work, cupping-glasses should be applied over the spot, until the tissues are thoroughly drained of blood. Cauterization of the injured spot is preferred by some physicians, and Mr. Youatt, the great authority on dogs, used it with over four hundred persons bitten by rabid animals, and he informs us never unsuccessfully. Four times he employed it on his own person, but there is a strong probability that the method at last failed with himself, for he ultimately committed suicide whilst supposed to be suffering from the initial symptoms of hydrophobia. He preferred the nitrate of silver or lunar caustic, but the actual cautery, as a red-hot iron is called, is often employed.

It has been denied by some physicians that there is such a disease as hydrophobia, but whilst there is little doubt that many cases of tetanus, hysteria, and perhaps deaths from mere fright, have been mistaken for hydrophobia, those who, like the present writer, have seen well-marked instances, are convinced that this terrible disease does exist.

No well authenticated example of recovery from genuine hydrophobia is on record, so that the best practical treatment we know of at present is to keep the wretched patient under chloroform for the two, three, or four days which elapse before death releases him. The curative action asserted to belong to curare or woorara is, however, deserving of further trial, and very recently cases of cure by this remedy are reported.

The value of Pasteur's discoveries in regard to the attenuation or mitigation of the poison of hydrophobia has not yet been tested upon man in a conclusive manner, but great expectations may rationally be entertained that his method, so successful in the canine race, or some

modification of it, will prove of immense service in protecting mankind from this dreadful disease.

After a person is bitten, unless it is by a dog, cat, or wolf, unquestionably rabid, great care should be taken of the animal. It should on no account be killed, but carefully shut up and watched to see whether madness does develop. Many persons accidentally bitten by dogs have suffered agonizing, yet needless, anxiety for years from neglect of this simple precaution. If the dog remains in good health for two weeks after it has inflicted a bite, the person so bitten may feel safe. One or two cases, however, seem to show that the angry bite of a bitch in heat, but without being rabid, may, in very rare instances, give rise to hydrophobia.

### INFANTILE CONVULSIONS OR FITS.

These spasms, which are so common and so alarming in young children, consist of alternating movements of contraction and relaxation, independent of the will. In some cases such attacks mark the onset of one of the eruptive fevers or other acute diseases, but probably the most common causes are the irritation of teething, and of worms in the intestines. The aspect of a child in convulsion is very distressing, but the danger, for the time at least, is much less than appears. The eyes are generally turned upward or rolled irregularly in their sockets, the face is distorted by a succession of spasms, and the arms and legs are jerked and twitched in various directions. For a short time there is often spasmodic interference with respiration, so that the breathing is very imperfectly performed, and the countenance of the infant becomes livid or pallid. The form of convulsion called by nurses inward spasms, or inward fits, is characterized by spasmodic contractions of the muscles about the throat, and those of the eye-balls without much movement of the limbs.

*Treatment.*—The treatment of a child during the convulsion is, of course, to be directed first towards relaxing the spasm, and, immediately after that is accomplished, to removing the cause of the trouble, which in two cases out of three will prove to be irritation of the gums, or of the bowels. To shorten the paroxysm the child should be at once placed in a warm bath, and a cloth wrung out of cold water applied to its head. In robust infants ice-water may be used, and mustard plasters should be spread over the back of the neck and along the spine. The child's gums ought to be examined if it is of the age for teething, and should they be found hot and swollen, promptly lanced and encouraged to bleed freely. It is advisable also if there is any suspicion that the convulsions arise from their usual cause, the presence of indigestible food in too great amount in the stomach or bowels, to relieve these overburdened organs of their oppressive load by a purgative injection, or an emetic, as indicated by the history of the case. Then if there is reason to suppose that



the intestinal worms, which most children harbor, are causing disturbance, active vermifuges such as a grain of Santonin before dinner and supper for a child two years old, followed by two grains of calomel at bedtime ought to be employed. Full doses of bromide of potassium, assafœtida, and valerian are often very useful in diminishing the excitability of the nervous system, which, as already pointed out, is especially great during the age of childhood.

### EPILEPSY OR FALLING SICKNESS.

This mournfully common disease is a complex condition, in which, as a rule, sudden and complete loss of consciousness prevails, associated with convulsions, tonic or continuous at first, but afterwards becoming intermittent, and which, for a time, impede the process of respiration.

In the severer form the epileptic fit is occasionally preceded by a premonitory symptom, the epileptic aura, as it is called, which consists in a very peculiar sensation of coldness, heat, or tingling, which usually proceeds up the arm or leg, perhaps to the head, which it reaches just as consciousness is lost and the fit comes on. The actual attack may be described in three stages: The first of these is often ushered in with a piercing shriek, or frightened cry, followed by absolute and instantaneous loss of consciousness, in which the patient falls down more or less violently. Tonic muscular contractions of various parts appear, by which the hands are clenched, the face hideously distorted, and the limbs twisted, breathing is suppressed, and the face becomes pale, and then livid or dusky; the pulse is exceedingly feeble, and the pupils of the eyes are contracted. This stage usually lasts from thirty to forty seconds. The second stage of the fit begins abruptly with the return of breathing, which at first is violent and irregular. Loss of consciousness still continues, but interrupted spasms replace the tonic variety. In these the features work, the eyes roll, the jaws champ, the tongue is frequently bitten, the eyes twitch, and the limbs and trunk are more or less violently convulsed. The patients foam at the mouth, and both urine and fæces may be discharged involuntarily. This stage subsides gradually, lasting from one to four minutes. The third stage is marked by a gradual return to consciousness. The muscular spasms cease, the patient opens his eyes, tries to get up, and looks bewildered. He is very much exhausted and mentally confused, and shortly afterwards usually falls into a deep sleep, which may continue for some hours. The fit is generally single, but occasionally two or more occur in immediate succession. More frequently they come on with an irregular periodicity, at intervals of about a week, or a month, the length of the interval being apparently influenced by various accidental causes. Between the fits the patient may feel quite well, although, as a rule, the general health is defective. If the malady continues, as it usually does,

the memory is apt to fail, the mind to become dull, and acute mania or imbecility supervene. A single fit is rarely fatal of itself, but the indirect risks of epilepsy are considerable. The hopeful cases are those which occur in the young, and which can be traced to some ascertainable and removable cause, for which treatment is commenced early.

Epilepsy must be distinguished from apoplexy, sunstroke, intoxication, hysteria, and pretended fits, and from the onset of eruptive fevers and other acute diseases. The main points upon which a diagnosis can be based are the infrequency of a first occurrence of epilepsy late in life, the sudden onset, the insensibility of the eye to the touch of the finger, the frequency with which the tongue is bitten or the face bruised, the frothing at the mouth, the short duration, the subsequent profound sleep, and the absence of, in many cases, severe or continued headache, of paralysis, or of emotional disturbance. When it does not first come on in childhood, in connection with the nervous excitement attending teething, epilepsy usually makes its appearance between the tenth and twentieth year, and there is often a distinct history in the family of epilepsy, insanity, or intemperance.

*Treatment*—The treatment during the fit consists in loosening the constricting clothing about the throat, preventing the patient from injuring himself in his struggles, and protecting the tongue from being bitten, if possible, by placing a cork or piece of India rubber between the teeth. Care must be taken that such an object does not pass into the throat and choke the patient, which can be prevented by tying a strong string to it. A tea-spoonful of fine salt crammed into the mouth is believed by many to shorten the paroxysm. Bleeding may be resorted to if the fit is very much prolonged, but is rarely necessary.

Confirmed epilepsy is incurable in the majority of cases, but bromide of potassium, valerianate of zinc, in conjunction with long-continued counter-irritation to the back of the neck, by means of a seton or tartar-emetic ointment, and total abstinence from animal food, appear most likely to prove successful. Strangely enough, this disease is very apt to improve temporarily under any new treatment, no matter how absurd, which takes a strong hold upon the patient's imagination.

A mild form of epilepsy is frequently met with, in which there is no complete loss of consciousness, but only a slight dizziness with turning up of the eyeballs, and lasting but a few moments. It should be perseveringly treated as just recommended, lest it lapse into the severer and more incurable variety.

### SPASMODIC CROUP, OR SPASM OF THE GLOTTIS.

This is the most important of several varieties of simple spasm in different parts of the body, among which ordinary cramp is a familiar

example. It is called also laryngeal spasm and laryngismus stridulus, and consists in a spasm of the muscles of the glottis or opening into the wind-pipe, by which a crowing or croupy cough is produced, with hard or stridulous breathing. This disease especially occurs in young children, where it is due to some reflex irritation, such as that of teething, reflected from the nerve-centres which control the muscles of the glottis. It may generally be distinguished from the alarming malady, true croup, by its coming on suddenly without fever, marked heat of skin or quickened pulse. To relax the spasm, sprinkling a little cold water in the face will often suffice, or tickling the fauces with the finger or with a feather, so as to produce vomiting, frequently answers the purpose. Should it fail, the child should immediately be placed in a warm bath. After an attack, the gums ought to be carefully examined, and freely lanced if found swollen, every attention being paid to the general health. Much needless alarm would be spared to anxious parents and nurses if it were generally understood that there is no likelihood of this disease leading on to that fatal malady, true croup, which may always be excluded from consideration if the child is free from fever, coughs loudly, and has no huskiness of the voice.

#### CHOREA OR ST. VITUS' DANCE.

In this remarkable disease the voluntary muscles seem to escape from the control of the will, and take on frequent and irregular movements, partly or wholly of their own accord. In some instances small groups of muscles, merely, are affected: in others, those of one or two limbs, or it may be those of all portions of the body. This disease generally occurs in children between the ages of six and fifteen years, and is apt to come on in an insidious manner. It is more common in females, and among the exciting causes are fright, violent excitement, worms in the intestines, and, apparently, acute rheumatism and heart-disease. When it makes a gradual onset, the child is perhaps noticed to be restless and fidgety, awkward in any complicated action which requires delicacy of adjustment, apt to jerk the limbs, make grimaces, or drop articles from the hand. There may also be some slight mental defect or emotional excitability. The choreic movements are at first insignificant, and limited to some part, such, for example, as the face or one arm, but gradually they become more violent, and often involve the whole body. The condition is then very characteristic, and once seen can scarcely be forgotten. In a well-marked case, the head, trunk and limbs may be twisted and jerked in every conceivable direction. But these movements differ from true convulsions in being evidently, although very imperfectly, inspired by some definite purpose. The features work, the eyes roll, the lips are in turn pursed up, separated, and drawn out, and the tongue is thrust for-



ward and turned from side to side, all in ways which would be exceedingly comical if they were not so pitiable in their grotesqueness. The head is jerked from side to side, the arms are variously and irregularly extended, flexed, and swung outwards, and the legs are similarly disturbed, so that walking, or even standing, becomes, perhaps, impossible, and the body may be tossed about so violently that the patient cannot be kept in bed. Food is taken with difficulty, and speech may be almost prevented, by the constant movements of the lips and tongue. These curious movements are intensified by any attempted voluntary action, by excitement, or by being watched, but they cease, as a rule, during sleep. The automatic movements, such as respiration and swallowing, are rarely interfered with. If the disease continues for many weeks, the affected muscles become weakened, and actual paralysis of one or more limbs may come on; the sensibility of the skin is impaired, the countenance assumes a blank and foolish expression, and the mind itself may in time grow seriously enfeebled. Functional, or even organic, disease of the heart is often present, but there is seldom any febrile disturbance. The average duration of chorea is from four to six weeks, and it seldom proves fatal except in consequence of inability to take food, or from the exhaustive discharge from bed-sores, produced by the constant friction in bad cases.

*Treatment.*—The medical treatment of chorea, when the disease is of only moderate severity, consists of the administration of tonics, such as iron, quinine, and strychnia, with phosphoric acid, and of arsenic, preferably in the form of Fowler's solution, in five drop doses thrice daily, which frequently exhibits a wonderful power over this malady. The fluid extract of black-snake root in quantities of a teaspoonful four times daily has often been employed with benefit. In severe attacks some relief from the violence of the movements must be obtained if possible, and this can generally be secured by fifteen grains of chloral, or sufficient to produce several hours sleep, and kept up the greater part of every twenty-four hours for several days. Care must be taken, of course, to administer proper nourishment during these periods of slumber, if necessary by rectal injection as already pointed out. In chronic cases the tonics before mentioned, with the addition of cod-liver oil and the hypophosphites, should be resorted to, and change of climate is very likely to be of service. Relapses are frequent, and on this account a constant watch should be kept up by parents over children who have once been affected with chorea, in order to guard them against whatever may have originated the primary attack of this mortifying complaint.

### HYSTERIA.

This disease, popularly spoken of as "the hystericks," is a functional disorder of the nervous system, during the existence of which almost

every disorder of a nervous kind, even such dangerous complaints as tetanus and hydrophobia, may be very accurately imitated without practical peril to life. Very often the symptoms are peculiar to the complaint, consisting of emotional excitement, with a tendency to sighing, crying, laughing, a singular sense of suffocation as if produced by a ball crammed into the throat, and often attended with curious muscular movements and convulsions. Hysteria usually makes its appearance between the ages of twelve and twenty-five years, is chiefly met with in women, although not absolutely confined to the female sex, and is rarely, if ever, fatal, although the symptoms often appear extremely alarming. The causes of hysteria are not well understood, but strong emotional excitement, certain sexual disturbances, and a want of definite occupation, certainly have an important influence in its development, at least in many instances.

Great difficulty is often experienced, as already hinted, in the diagnosis of this curious complaint. In the hysterical fit, which may simulate that of epilepsy, the insensibility is rarely complete, the eyelids are closed and tremulous, and the pupils expand in shadow and contract when exposed to a bright light. The patient does not bite her tongue, and is rarely careless enough to injure herself, there is no foaming at the mouth, the fit is not followed by coma, and it never comes on during sleep. Where hyperæsthesia or anæsthesia are feigned in hysteria the conditions are seldom complained of in exact accordance with the anatomical distribution of the nerves of a part, and hysterical hemiplegia or paraplegia may be detected by their frequent association with pretended complete anæsthesia, or with rigidity from the beginning of the attack, and by the absence of bedsores.

*Treatment.*—In the treatment of a hysterical fit, firm and considerate behavior, without the exhibition of the slightest anxiety, aided perhaps by a douche of cold water, will general suffice to arouse the patient from the paroxysms. In bad cases chloroform may be given with advantage. During the intervals between the attacks, the bitter tonics, cod-liver oil and iron, and treatment for any uterine derangement, as described in the chapter on Diseases Peculiar to Women, should such disorder exist, are strongly indicated and will generally accomplish a cure in the course of time.

CATALEPSY or trance is a condition allied to hysteria in some respects, in which the whole frame lies prostrate and helpless, so that a limb, if lifted up, falls back as if it were relaxed and dead, whilst yet the consciousness of the person affected may be retained without the sensitiveness to physical pain. This curious state of existence is not well understood, and in our present ignorance of its nature, the chief importance lies in its being distinguished from death early enough to prevent that most horrible of all human misfortunes, the being buried alive. Although many signs of death have been described, especially for the purpose of

avoiding this catastrophe, it is probable that the progress of decomposition in the body is the most practically useful indication of cessation of life.

**HYPOCHONDRIASIS** is a very obstinate affection, often hereditary, and occurring more frequently in men than in women. During the attack there is apparently great depression of mind, without actual mental disease. The patient imagines he is afflicted with maladies of the most varied kinds, is tormented with ideas of impending miseries and dangers, thinks he suffers from swellings or contortions of the body, which may be purely creations of his fancy, gives his physicians it may be eloquent descriptions of pains and sufferings, which if real would quickly destroy life, and entertains a most exaggerated conception of his agonies and the imminence of impending death. This disorder in the male corresponds very nearly to hysteria in the female, and like it can only be cured by attention to the general health. Tonics, exercise, and cheerful occupation, are the best remedies.

### NEURALGIA.

The term neuralgia is applied to a disease characterized by pain along the course of a nerve. The suffering is generally severe, often excruciating, but is to a certain extent paroxysmal, remitting for a time, and then returning with perhaps renewed violence. It may arise from exposure to cold, from injury of, or pressure upon, a nerve, from changes in the electrical condition of the atmosphere, or from direct implication of a nerve in some morbid process, but frequently no adequate cause can be discovered. It is especially apt to occur in those of a nervous or hysterical temperament, and in those who are debilitated from any cause. Wherever seated neuralgia presents certain characteristic features. In the first place the pain is often very intense, and is variously described as aching, boring, shooting, burning, and so forth. On examination of the affected region by gentle pressure of the finger, one or more tender spots may generally be found, with an invariable position in relation to each large nerve in the body, and these are usually near the place where that nerve finds its way out through some opening in a bone, or through a dense and strong membrane, such as takes the name of a fascia. The pain of neuralgia is often associated with loss of the sense of touch, with reflex, muscular twitchings, with congestion of the affected surface, and occasionally with vesicular eruptions upon the skin. It is further characterized by its tendency to shift about from one spot to another in the course of the same or of some other nerve, and also by its being almost always upon one side of the body only. As to the general health it may be stated that neuralgia is always dependent upon debility arising from one cause or another, as, for instance, anæmia, mental anxiety, gout, rheumatism, syphilis, and



dyspepsia. In fact, a great German authority upon nervous diseases declares, with as much truth as poetry, that "neuralgia is the prayer of the nerves for iron in the blood."

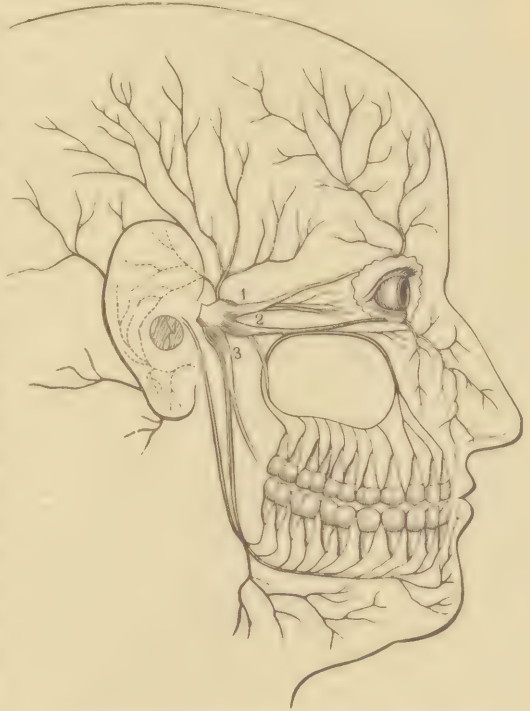
Neuralgia may attack any nerve of sensation, whether it is distributed to the skin or to the internal organs. Special terms are in use to designate neuralgia of particular nerves, as, for example, sciatica for neuralgia of the great sciatic nerve at the back of the thigh, gastralgia for neuralgia of the stomach, and *tic-doloureux* for neuralgia of the fifth or tri-facial nerve, distributed to the teeth and side of the face. Next to the sciatic nerve, no other is so often the seat of neuralgic pain as the trifacial, and this is, perhaps, partly owing to the fact that the superficial branches are spread out over a large surface upon the side of the face, and more exposed

to cold and changes of the weather than any other part of the body where the epidermis is equally delicate. Terminal branches of the trifacial come out through the bones of the head at points over the eye, beneath the eye, and at the side of the chin, as shown in the marginal illustration. These, then, are the tender points, when all the branches of this nerve are involved in the neuralgia, and it is from these points that the darting, boring pains seem to radiate. If the neuralgia is primarily limited to the first branch of the fifth pair, the pain spreads out in the subdivisions of the supra-orbital nerve, as it is called, affecting especially the forehead, eye-

brow, upper eyelid, and sometimes the eye itself. After this threatening symptom has lasted a few hours, or a few days, the patient may be seized with a violent, darting, or shooting pain in the course of the nerve, returning at short intervals after a very brief respite. The paroxysm is short, continuing only a few seconds or a few minutes, but the suffering is, perhaps, the most severe that the human frame is capable of enduring.

Hemierania or migraine is a combination of neuralgic symptoms with ordinary headache occurring in paroxysms, and usually limited to one

FIG 31



DISTRIBUTION OF NERVES ON THE SIDE OF THE FACE.

side of the head or brow. It is apt to commence in childhood and go on to advanced age, occurring in both sexes, but more often in women than in men. In women the attacks are especially apt to appear just before the menstrual period, or during its course. At other times, and in the male sex, mental excitement, or intellectual overwork, seems to aid in bringing on a paroxysm. The headache is probably due to excitement of the sensitive filaments of the trifacial nerve, distributed to the dura mater, and also to the sympathetic fibres accompanying the blood-vessels, which connect the nervous supply of the brain with that of the stomach so intimately. As generally manifested it increases rapidly soon after waking in the morning, with chilliness, loss of appetite, sliminess of the mouth, sickness at the stomach, vomiting of a little greenish fluid, and at last the headache becomes so intense as to be almost unbearable. The eyes are extremely sensitive to light, and the ears to sound, so that the darkest and most retired rooms are anxiously sought for, and absolute seclusion is desired. The pulse is often unnaturally slow. Generally no relief is obtained, except by treatment, until after a night of sound sleep, which may not come for forty-eight or even seventy-two hours; but after such profound slumber the patient awakes next morning free from pain, although much depressed and exhausted.

Sciatica is often associated with both rheumatism and gout, but is also frequently brought on by catching cold. Occasionally it is due to accumulations in the bowels, or to disease of the bones through which the nerve makes its exit. The painful points are usually found back of the trochanter, or most projecting part of the thigh bone, at certain spots in the thigh, about the knee and ankle joints, and on the top of the foot. The disease rarely begins suddenly in its full severity, but develops gradually, and slowly becomes intense. In order to relieve the pain, which is made worse by putting the fascia of the thigh upon the stretch, the leg is kept bent, and from want of free use in chronic cases the muscles may waste, in consequence of the absence of due exercise, and the limb therefore diminish in bulk. Effusion of fluid may take place into the sheath of the nerve, and is indicated by a dull, aching, benumbing pain, succeeding to intense suffering, cramps, twitching, and inability to use the limb. Usually sciatica is an obstinate disease, lasting for months, or even for years, and when cured very liable to relapse. No danger to life, however, attends upon its occurrence.

Intercostal neuralgia, like intercostal rheumatism, resembles the pain of pleurisy and of pneumonia, and has often given rise to unfounded anxiety as to the existence of these more dangerous diseases. It may be at once distinguished by careful examination of the lungs.

Neuralgias of the arm, neck, shoulder, leg, and so forth, are all unhappily common, and sometimes very intractable.

*Treatment.*—In the treatment of neuralgia the first thing is always to

relieve the excruciating pain, and for this purpose there is no remedy so prompt and so certain as the hypodermic injection of morphia. If employed for the first time this must, however, be used with great caution, and the danger of falling into the ruinous opium habit is so great that only a skilled physician should be trusted to administer morphia in this way. Neuralgic pain may also be relieved, but less promptly, by opiates taken either by the mouth or by enema, and its equivalent the suppository, and the effect of opium thus employed may sometimes be advantageously increased by combination with hyoseyamus, belladonna, and with the bromide of potassium. In some instances application of the galvanic current will remove the pain of neuralgia as if by magic, and when relief can thus be secured it is far preferable, as the distressing sickness, headache and constipation, which so often result from opium and other narcotics, may thus be avoided. Hydrate of chloral or croton-chloral will sometimes answer the purpose as a palliative if the suffering is not very severe, and the tincture of veratrum viride is occasionally beneficial, but the latter is a powerful remedy and must be employed with great caution. In order to effect a cure of neuralgia our main reliance must be placed upon improvement of the general health by the best food, and the vegetable tonics, such as quinine-bark, nux vomica, gentian, and columbo. If there is any tendency to anæmia, as is generally the case, iron is urgently called for, and should be administered as advised in the article on anæmia, for which see page 409. The hygienic treatment is almost equally important with the medicinal, and a thorough examination of the habits of life pursued by the patient will almost always lead to the discovery of some violation of sanitary law, which must be corrected before a hoped for cure can be realized. Thus whatever errors or excesses in diet, mental or physical exercise, sexual excitement, sedentary habits, the abuse of alcohol, and the use of tobacco are being committed should be abandoned, since without such relinquishment the medicines above mentioned can only palliate the suffering. Where all other means fail, as in rare instances does happen, a portion of the diseased nerve has been dissected out, and by thus completely removing the power of sensation from a portion of the face, a cure has been effected.

Dr. Brunton, in a very recent article, points out that frontal headache with constipation is usually relieved by purgatives, whilst frontal headache, seated just above the eyebrows, without constipation, is relieved by acids, and a similar headache, situated higher up at the roots of the hair, is relieved by alkalis. Headache upon the top of the head is usually associated with anæmia, and is cured by iron. Rheumatic headache may be successfully treated with iodide of potassium, or salicylate of soda.



### INSANITY OR MADNESS.

Insanity is disorder of the intellect, and we meet the same difficulty in establishing a strict dividing line between the borders of sanity and insanity that we have already found in separating health from disease. A certain amount of eccentricity, or peculiarity, is by common consent admitted to be compatible with sanity, and beyond this is a narrow strip of debatable ground, as it were, which, according to personal predilection, prejudice, or habit of thought, will sometimes be adjudged to one province and sometimes to the other. Well-marked cases of insanity, however, are without difficulty arranged in the following classes: Mania, melancholia, dementia, paralysis of the insane, idiocy and imbecility.

• Mania is defined to be a disturbed condition of the mind in which there is a false notion of existing facts and things, either personal or general, together with excitement, extending from the slight degree of mere warmth or haste of expression up to actual frenzy. There are two varieties of mania, the acute and the chronic. In the acute form the excitement is extreme, and follows closely upon the delusion or derangement of ideas. In the chronic form, the delusion or derangement is confirmed, but less obtrusive, whilst the excitement is subdued or comes on at long intervals. Mania has generally a sort of stage of incubation, during which sleeplessness is one of the most important and earliest symptoms. Besides this, at first there may be trifling irregularities in the affections. The maniac may be at the outset either sad or gay, active or indolent, indifferent or eager, but he soon gets impatient and irritable, neglects his family, forsakes his business and household affairs, deserts his home, and yields himself to acts which strikingly contrast with his ordinary mode of life. Periods of agitation and composure succeed each other, and so do acts the most strange and extravagant. In many instances the kindest love and tenderness of domestic life serve but to irritate and provoke him, so that to remain among his family excites the patient by slow degrees to the highest pitch of fury. In another class of patients, the primary symptoms are those of gloom and despondency, out of which the maniacal excitement appears to develop. In both varieties, there is generally a marked departure from the individual's usual state of physical health. The different forms of mania in which the disposition to commit murder, suicide, or arson, or to steal, is quite uncontrollable, are well known. When a single tendency of this kind is very prominent, the case is usually denominated one of monomania.

Melancholia is a form of mental derangement marked by extreme depression of both mind and body. The mind is filled with sad and hopeless thoughts, and frequently with a disposition to accomplish self-destruction as the shortest mode of closing a miserable and intolerable life. The disease is seldom developed until adult life is attained, but

indications are often temporarily present in childhood, in those subject to it. It is almost always attended with dyspepsia, irregular action of the heart, and sleeplessness. The disposition to abstain from food and drink is often very strong, sometimes almost unconquerable. The very attitude is in itself characteristic, the head is bowed on the chest, answers are given to questions, if at all, in monosyllables, or with effort after a considerable pause. This form comes next in frequency of occurrence to mania, it is often hereditary, and all its varieties are disposed to be remittent. Of these, religious melancholy, and an exaggerated homesickness, are the most remarkable.

Dementia is literally a want of mind, and the word indicates a condition in which there is feebleness of intellectual grasp, or attention, imbecility of word and act, and general deficiency of mental power. It is one of the common terminations of both mania and melancholia, and if long continued, its outward signs are a vacant and puzzled look, a lack-lustre eye, a weak smile, and a meaningless laugh. This kind of insanity is almost a natural termination of extreme old age, and is then called senile dementia. Not infrequently the subjects of it become paralytic.

Imbecility is a condition in which the mind is from birth unfitted for the active and thoughtful duties of life, and in which the person affected is said to be half-witted, or wanting in general intellectual capacity. This condition of deficient mental development may be associated with moderately good physical health in early life, but there seems to be usually some taint in the system, so that the family of imbeciles is, as a rule, short-lived, the members dying early of consumption, diabetes, or some degeneration of the brain and spinal cord.

Idiocy is a still lower grade of mental weakness, in which the intellectual faculties are below the standard necessary for reasonable life. In the true idiot the head is of a reduced size, and the appetites and propensities are very little, or not at all, controlled by reason. Many idiots are deaf and dumb, but most of them retain their sight. The sad condition of these poor creatures may be often ameliorated by systematic training, but complete cure after puberty is hopeless.

*Treatment.*—The treatment of insanity is generally best carried out in asylums for the purpose. To quiet a patient temporarily, or on his way to a suitable institution, bromide of potassium in quantities of thirty grains, or chloral in fifteen grain doses every two or three hours, morphia by hypodermic injection, or otherwise, and even chloroform by inhalation may be necessary.

## CHAPTER VIII.

### DISEASES OF THE EYE, EAR, AND NOSE.

The diseases of the eye are so important, and serious injury or loss of the organs of vision is such a terrible misfortune, that they demand a careful consideration. For the better comprehension of this group, it will be needful, however, to give some preliminary explanations in regard to the eye, and also the ear and nose, with their appendages.

The eye is probably the most wonderfully ingenious and complex organ of the human body, and being proportionately delicate, requires to be guarded with the greatest care. Few catastrophies are more grievous than that of total blindness, and most people would rather lose all the other senses than be deprived of sight. The intricate structure of the eye may perhaps be best comprehended if we remember that its general plan is that of a photographer's camera, the convex glass in the front of which corresponds with the crystalline lens of the eye, a picture of external objects being formed upon the artist's ground-glass plate in the one case, and upon the retina at the back part of the eyeball in the other. Now, the retina is simply the expanded optic nerve, which has the peculiar power of perceiving lights or colors, and the chief difference between the eye and the camera is, that in the former temporary impressions only are perceived by the brain, through the optic nerve and retina, and in the latter instrument these temporary impressions are intended to be rendered permanent on the sensitive plate or paper, as a photographic picture. The eye is carefully protected from accidental injury by being imbedded in a deep cavity or socket in the solid bones of the face and head, which guard it jealously from attack on either side and at the back. This socket is much larger than the eye itself, and the bony cavity is filled up behind and at the sides of the eyeball with an admirable cushion and packing of soft fat. The eye itself, as can be readily seen in that of a pig or sheep from a butcher's shop, is a white ball almost exactly round, except where the clear circle projects a little in front. This clear part, called the cornea (1), is as transparent as glass, and is set in the space made for it in the white part of the eyeball, very much as a watch crystal is set in its frame. The white portion of the ball, called the sclerotic

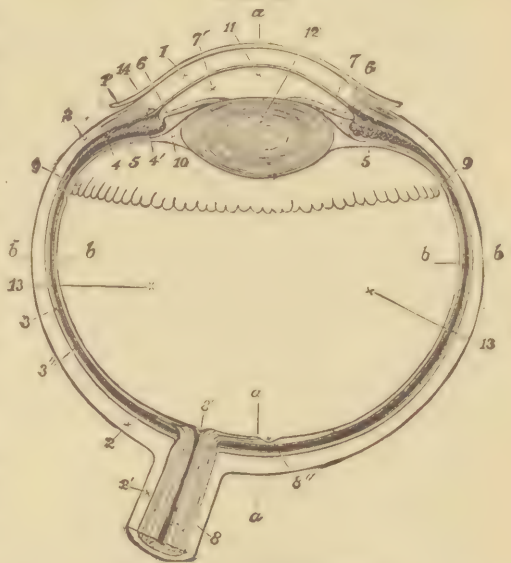


coat (2), is a tough membrane, very strong and dense, which gives shape to the organ of vision, and protects the extremely delicate structures within. The cornea and sclerotic coat each average about one-twentieth of an inch in thickness. Inside of the cornea is a circular curtain, with a round hole in the middle, called the iris (7), so named because it varies so much in color, being frequently blue in blonde individuals, and brown or black in brunettes. The

round hole in the centre of the iris is called the pupil, and is the black spot seen on looking into a person's eye. This spot varies in size according to the amount of light, being larger in the shade and smaller in bright sunshine. In human beings it always remains round, unless the iris is diseased, but in the cat, for example, it changes its shape, becoming a narrow slit in a strong light. This closing up of that curious curtain, the iris, is a beautiful provision for shutting off an excessive amount of light, which would otherwise pass

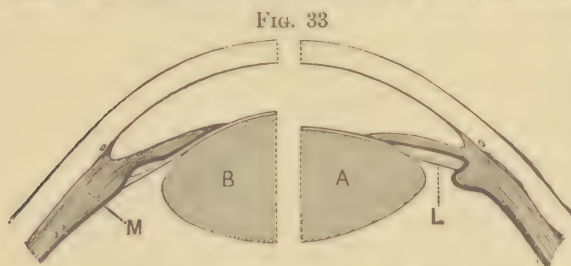
through the pupil in too great quantity, and irritate the sensitive parts of the organ of vision within. The sclerotic coat is lined on its inside with a thin layer of black membrane, called the choroid coat (3), which seems to have almost exactly the same object as the black lining of the photographer's camera, namely, to absorb any extra rays of light, and so prevent the picture from being indistinct. Inside of the choroid coat, and immediately in contact with it, lies the retina, a third hollow ball, made up of an expansion of the optic nerve, which enters the eye at the back (8), through openings in the sclerotic and choroid coats. The retina is made up of several layers, the outermost of which is formed by the terminations of the nerve-fibres in what are called the rods and cones of vision. These rods and cones are so wonderfully sensitive that through them we can perceive the differences of color and outline in the images of objects formed within the eye. They therefore correspond to the sensitive plate in the camera of a photographer. The remaining portions of the eye are chiefly useful in forming this image of which we take cognizance, and act upon the light exactly as the lenses of an opera-glass or of a camera do, except that they are provided with a more convenient way of changing the focus as may be required. The first of these which

FIG. 32



SECTION OF THE HUMAN EYE.

the light reaches, after it penetrates the cornea, is the crystalline lens (12), which, as can be readily seen by squeezing it out of the eye of a pig or sheep after death, is very much like a large dew-drop or rounded diamond, in size, shape, and general appearance, and is solid enough to bear gentle handling. It has the form of a small, thick magnifying glass or lens, and if held over the letters of a printed book, is at once seen to have the same power of making objects seen through it look larger. The crystalline lens is placed in the eyeball a little behind the iris, and is large enough to extend out beyond the edge of the pupil, unless that opening in the curtain is wider than usual. If it were not so perfectly transparent we could see the crystalline lens every time we looked a person straight in the eyes, as is shown in cases of cataract, a disease where the lens becomes first milky and then opaque, so that its position can easily be recognized, and the edge of the iris seen to move over it, as the pupil expands and contracts under the influence of varying degrees of light. Every one who has looked much through a telescope, or opera-glass, knows that a different arrangement of focus is needed to show a near and distant object clearly, and that this altered focus is obtained by adjusting the relative position of the component lenses. In the living eye, nature contrives to obtain this necessary effect of two or more lenses with a single



THE FLEXIBLE CRYSTALLINE LENS.

one, by making that one (the crystalline) soft enough to change its shape a little, as shown in the diagram, and then providing a muscle called the ciliary muscle (M), through the action of which the lens may become more

convex, that is, rounder (as at B), and so enable us to see near objects more distinctly. It is the mechanical effort required to keep this little muscle constantly on the stretch that causes the eyes to feel so tired after long application over reading small print or doing fine work of any kind. Hence, avoidance of too prolonged a strain of this nature is an important part of the hygienic care of the sight, on account of such a tendency as exists to exhaust the power of this muscle. The space between the crystalline lens and the cornea is filled by the aqueous humor (11), a watery fluid bathing the front and back of the iris, which, floating thus in a clear, transparent fluid, has an opportunity to move with entire freedom, and so most perfectly perform its duty as a curtain to shut off any excess of light whenever there is danger of a superabundance injuring the sensitive retina within. The aqueous humor, being shut in by the convex cornea, must, of course, take the shape of that clear membrane, and, forming with it a convex lens, still further aids the crystalline body in bringing the

rays of light to a focus upon the retina, and so forming a sharp image upon that sensitive membrane. The action of the aqueous humor in this instance is precisely similar to that of water poured into a glass globe standing in the sunshine. Whilst the globe is empty, it has but little effect in concentrating the sun's rays into a focus, but when filled with water, its power as a lens is considerable, and it may even operate so energetically as a burning-glass as to set fire to inflammable substances placed at a proper distance. Want of suitable curvature, and also in many cases the fact of its being curved unequally, in different directions, by making the lens or magnifying glass too strong or too weak, has much to do with causing imperfect sight.

The chief bulk of the eye is made up of the vitreous humor, which receives its name from its vitreous or glassy appearance. This fluid is contained in the cavity of the retina, and has running through it numerous, fine, interlacing fibres, as transparent as itself, which probably help to prevent the delicate retina from being injured by its shaking about during violent movements of the head and body. The vitreous humor has little or no share in aiding to form the image upon the retina, but does perform an important duty in keeping the globe distended, so that in a sound eye the retina is held at the exact distance, where it can receive images of objects cast upon it in their sharpest and best defined condition. An excellent way to understand fully how the eye acts as an optical instrument, is to actually make a camera of the eye of an ox or other large animal, by cutting away the sclerotic coat at the back part, and then shading this in a small box for instance, so that the images formed by cornea and crystalline lens can be seen inverted upon the translucent retina at the hinder portion of the eye.

The diseases of the eye, according to the nomenclature here followed, are seventy-five in number, so that it is impossible properly to describe the treatment of any but the more important. Among the first of these is to be ranked the diseases of the conjunctiva.

### CONJUNCTIVITIS OR OPHTHALMIA.

This is an inflammation of the delicate membrane over the front of the eye, covering the whole of the cornea, and the part of the sclerotic coat or white of the eye, which is naturally visible. The usual symptoms of inflammation can no where be observed more distinctly than in the eye; the four great characters of this morbid process, as described by Celsus, about the beginning of the first century, being very apparent. Here, as elsewhere, redness, heat, pain, and swelling are the indications of inflammation, just as they were in the days of the old Roman physician, more than eighteen hundred years ago. The redness of the eye in this affection varies with the intensity assumed, but in severe cases it may



completely obscure the white of the eye, so that the whole surface, except the cornea, appears quite red. The pain and burning heat of the eye are sometimes almost unendurable. The swelling of the conjunctiva is often so considerable as to rise up all round the edge of the cornea, and this projection of the inflamed membrane may be so great as to prevent the eyelids from being closed. Intolerance of light and profuse flow of tears, the latter resulting from irritation sympathetically extended to the lachrymal gland, which supplies those persuasive drops of salt-water, are common symptoms in some forms.

Catarrhal conjunctivitis or catarrhal ophthalmia, as it is also named, is the form of this affection usually produced by cold. Redness and pain, as if a particle of dust had got into the eye, with a free discharge of water, are the first symptoms. Intolerance of light is not very great, unless the cornea becomes involved. Vision may be slightly obscured, but is seldom seriously affected.

*Treatment.*—The treatment consists of active purgation with calomel and jalap, followed by epsom or rochelle salts. Soothing lotions to the eye, as for example, that of sassafras pith with a little extract of belladonna to begin with, and, after a day or two, applications of weak solutions of nitrate of silver or lunar caustic should be used. Although the caustic solution smarts severely at first, it leaves, after fifteen or twenty minutes, an astonishing feeling of relief to the affected organ, and in favorable cases rapidly reduces the inflammatory action. To prevent the eyelids from adhering during sleep, and so aggravating the trouble when pulled apart in the morning, glycerine ointment, or a very dilute ointment of the red oxide of mercury, may be used with advantage.

Pustular ophthalmia, called also phlyctenular conjunctivitis and strumous ophthalmia, is the form in which the serofulous predisposition to disease is very apt to manifest itself in young children, as already mentioned on page 49. In this affection general treatment for the constitutional disease is the most important, but the local application of solution of lunar caustic, and of a corrosive wash, with lotions of belladonna and opium, are very useful.

Purulent ophthalmia is a more violent and contagious form of conjunctivitis, in which the sight is sometimes seriously endangered. The discharge of thick yellow pus or matter is abundant, and the inflammation sometimes progresses with great rapidity. Active purgation, leeching followed by blisters behind the ears, and application of the stronger solutions of nitrate of silver, are often necessary to preserve the sight. In the contagious variety great care must be taken to avoid conveying the disease from the sick to the well by the use of soiled towels, handkerchiefs, and so forth. In bad cases it is probable that the infection may occur by being wafted along in the atmosphere through a large room, or even through a whole house, as is seen sometimes in boarding schools and children's infirmaries.

Purulent ophthalmia of infants is another contagious form of the disease, affecting new-born children and sometimes destroying the sight. It requires, therefore, active treatment from the beginning, and the strong solution of nitrate of silver, distressing as its application seems, ought to be used faithfully. It is probable that most cases might be prevented if the physician were warned in time of the existence of any source of infection from the mother during labor.

Granular conjunctivitis or granular lids is a condition of the eye often left as a chronic state by the other varieties described. In it the inner sides of the lids become rough, inflamed, and covered with little projections which irritate the cornea at every movement of the ball or lids. It seriously affects vision, and is often very obstinate, but can generally be cured, or at least vastly benefited, by perseverance in constitutional treatment and local applications of nitrate of silver solution, or sulphate of copper, to the granulations.

### DISEASES OF THE CORNEA.

Keratitis or inflammation of the cornea may occur from a punctured wound of the eye, or it may be the result of the scrofulous diathesis, or even more commonly of inherited syphilis. It occasionally results in ulceration of the cornea, which sometimes perforates this structure and, allowing the humors of the eye to run out, irrevocably destroys the sight. Local treatment of the accompanying conjunctivitis and the use of atropia to keep the pupil dilated, so that it, the iris, may not become involved in the inflammation, are important, but the chief reliance must be placed upon constitutional remedies for those general diseases, of which this affection of the eye is little more than a symptom. The white spot or scar left by an ulcer of the cornea is generally permanent, and not only disfigures the organ of vision, but more or less completely obscures the sight for life. Since a scar of this kind is so injurious and when once fully formed can scarcely ever be removed, the ounce of prevention is of tenfold importance, and every care should be taken, by securing the most skilful treatment for ophthalmia as promptly as possible, to reduce to its smallest dimensions the danger of such a catastrophe to sight.

### DISEASES OF THE SCLEROTIC COAT.

Inflammation of the sclerotic coat, or sclerotitis, is generally characterized by the intense, deep-seated pain it causes, and by the pink hue of the white of the eye produced. The chief varieties are the rheumatic and the syphilitic, and the treatment is to be more especially directed towards counteracting by general remedies the poisons of these two virulent constitutional affections.

### IRITIS.

This is an inflammation of the iris, which may be simple or gouty, syphilitic or scrofulous. Its symptoms are intense pain in most cases, although in others little uneasiness is felt; change in color of the iris, contraction of the pupil, and impairment of vision. Inflammation of the iris has always possessed a great interest for physicians, because it is the only cavity lined by a serous membrane into which we have the privilege of looking and seeing what is going on when the membrane which forms its boundary is inflamed. Hence, the observation of a case of iritis is not only the most interesting, but also the most instructive, lesson in the sciences of pathology and therapeutics which nature ever vouchsafes to us, as we carefully watch the progress of the disease and the effects of medical treatment from day to day. Since one of the greatest dangers of iritis is that the pupil will be drawn together by the whitish lymph infused in the inflammatory process, and, by being thus closed, shut off the sight, it is very important to keep this opening of the pupil as large as possible by the use of belladonna, or its active principle, atropia, throughout an attack of iritis. Besides this, general bleeding, or free leeching behind the ears, or on the nape of the neck, followed by repeated blistering, should be employed, and active purgatives with mercury to slight salivation, contribute toward the cure. Opium by hypodermic injection to relieve the intense pain, and cool anodyne applications to the affected organ, are valuable palliatives.

### RETINITIS AND CHOROIDITIS.

These maladies are respectively inflammations of the retina and the choroid coat, and they seldom occur alone, appearing usually in association with ophthalmia, iritis, and so forth, which more urgently call for medical treatment at the time.

### AMAUROSIS OR GUTTA SERENA.

This is a disease of the retina, dependent upon various changes of the retinal surface, and ending in an inability of the nervous expansion to receive and transmit visual impressions from the outside world to the brain. Amaurosis may be produced by exposure of the eye for a longer or shorter period to a white, dazzling object like snow, and snow-blindness is the most familiar example of this affection. It also occurs occasionally from accidents, such as lightning-stroke and blows on the head; or it may be due to degenerative changes in the retina following exhausting illness, or connected with sympathetic irritation; excessive use of tobacco sometimes produces it. Where the cause of amaurosis can be discovered



and removed, some hope of cure may be indulged, but ordinarily the melancholy fate of becoming permanently blind—as the poet Milton was rendered by this malady—awaits the patient. Of course, the earlier treatment is undertaken, the better is the chance of arresting the malady before utter destruction of the sight is accomplished.

### CATARACT.

This is an inappropriate but long established term indicating an opacity of the crystalline lens of the eye. In cataract, the lens becomes white and opaque, first at some point on its surface, or in the capsular membrane which envelopes the albumenoid substance of which the lens is composed. The opacity extends, until at length the whole of the lens may be involved, and blindness rendered complete. The development of cataract is usually slow in its progress, except in the case of diabetic cataract, or cataract from a punctured wound, which may form in a few days. The process of becoming totally opaque is called by surgeons the ripening of the cataract, and it is customary to wait for the cataractous change or ripening to be complete before any operation is attempted for its cure. No medical treatment, as yet discovered, is of any avail in the treatment of cataract, but the disease may be entirely remedied by the operation of extraction, which is illustrated in the accompanying figure. As there shown, a peculiar, wedge-shaped knife, called a cataract-knife, is used to cut an opening in the edge of the cornea, through which the opaque lens is carefully drawn out, and then the eye closed

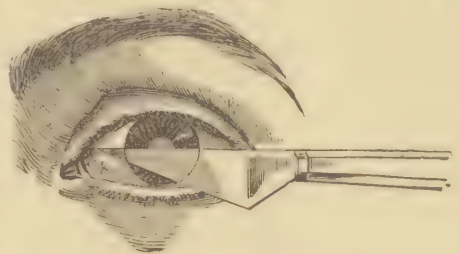


FIG. 34

OPERATION FOR CATARACT.

up and permitted to heal. When successful, as this operation proves in the hands of skilful oculists nearly nine times out of ten, useful vision is restored, and by the aid of very thick spectacles, to substitute the lost crystalline lens, the patient is often enabled to read, write or sew, as well as before being attacked with this disease. This operation of extracting the cataract is generally the most successful with the common form, which occurs in old people, where the crystalline lens is not only opaque, but hardened into a sort of horny substance. In some of the other varieties of cataract, such as that produced by wounds or other injuries, especially in young people, the treatment by breaking up the lens with a very delicate knife, about the size of a large needle, is resorted to with success. The old-fashioned operation for cataract by couching, or reclinacion of the opaque crystalline lens, is now generally abandoned, as being much less satisfactory in every way than the process of extraction. The tendency to the

formation of cataract is often hereditary, but something can be done by hygienic care of the eyes, to avert, or at least to postpone, its active development. Since it has been found that operatives who use their eyes opposite to a very strong light—such as glass-blowers—are particularly liable to cataract, it is advisable to avoid such exposure as much as possible. Very probably the electric lights now coming into such general use, as a counterpoise to their many hygienic advantages, will tend to promote the formation of cataract, unless guarded with special care. It is a curious fact, however, and one which at once disproves the fanciful theory that cataract is a disease of over-civilization and excessive study, that cataracts are frequently met with in animals, especially the horse, where the disease may often be seen in great perfection.

### GLAUCOMA.

This is a disease in which the globe of the eye becomes large, dull, and tightly distended, with the pupil dilated and fixed, and the depths of the organ of vision exhibiting a greenish color, from which the name of the malady is derived. It is attended with much pain and usually followed by loss of sight, is rather a common affection occurring more frequently in men than in women, but not usually commencing before the period of middle life. It often appears to be hereditary, and connected with a gouty or rheumatic taint, but especially develops in those whose systems have been prematurely worn out by excesses of various kinds, or who are enfeebled by constitutional disease.

### ASTHENOPIA OR WEAK SIGHT.

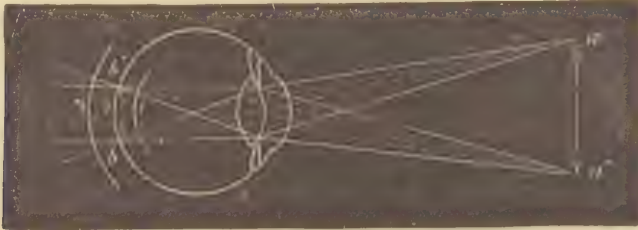
Weak or enfeebled sight, though a term in familiar use, is not easily defined as specially connected with any constant change in the eyeball. It may be due to an irritable condition of the retina, or to an impoverished state of the blood. More frequently, perhaps, it arises from a want of power to keep up the accommodation of the eye for distances, to nervous anxiety about the sight, or to the commencement of one of the serious organic diseases about the eye and its appendages. Except in the latter case, much can be done by treatment, using general and local tonics; and by care of the eyes in the mode to be pointed out in the next article.

### SHORT-SIGHT OR MYOPIA.

This is a very common condition of vision in which, from the greater convexity or improper position of the lenses of the eyeball, the focus of parallel rays of light does not fall upon the retina, but at some point in the vitreous humor. This error of development, as it often is, will be

better comprehended by the aid of the annexed figure, in which is shown a diagram of the eyeball and the course of the rays of light, to form a clear and distinct image of the arrow, on the retina at *b, b*. If however, the eyeball is elongated, so that the retina occupies the position of the line marked *3*, as is often found to be the case in near-sighted persons, it is obvious that the rays of light will have passed their true focus, and consequently when they reach the retina in this wrong position can only give a blurred and indistinct image of the object.

FIG. 35



THE ERROR IN CURVATURE OF LENS.

*Remedy.*—The remedy for myopia is the use of a concave glass, accurately adapted to the particular eye for which it is employed, and just strong enough to render the rays of light so divergent when they strike the cornea that they will be brought to an exact focus upon the misplaced retina, in its unnatural position, making in this way one error precisely counterbalance the other. This remedy should by all means be applied even in early youth, in order to prevent the effort of accommodation, the straining of the eye to see as much as other children do at school and elsewhere, from not only increasing the myopia, but laying the foundation of more serious disease and ultimately, perhaps, destroying the sight.

The alarming increase of myopia, and especially its prevalence among young people of both sexes in city schools, must have caused many observant biologists to speculate as to the exact mechanism by which the unfavorable influences of our present civilization were at work so as to bring about this rapid deterioration of the visual organs in the last few generations of mankind. To Drs. Cohn, of Breslau, and Liebreich, of London, we owe the best exposition of the causes of this serious misfortune, and the most advantageous methods of counteracting them. Nearly twenty years since Prof. Cohn reported, that in his investigations in Germany, he had found among ten thousand students one thousand, or ten per cent., were myopic. All the schools in which he made his examinations included some near-sighted individuals, but in the village schools these unfortunates were found in the proportion of only one and four-tenths per cent., whilst in city schools rather over eleven in every hundred were affected with myopia. Furthermore, in the primary city schools the proportion was six and seven-tenths per cent. In schools of the second



grade myopes were met with in the proportion of ten and a half per cent. In normal schools the percentage rose to nineteen and seven-tenths; and in the gymnasia or highest schools to over twenty-six per cent. In the first class of the gymnasia *more than half the pupils were myopic*. From these researches of Dr. Cohn, amply confirmed by other observers in various parts of the world, it appears indubitable that the work of reading and writing brings about this lamentable development of myopia. There is no doubt also that myopia is hereditary, and that according to the great law of "the extinction of the unfit," as explained on page 44, the children of myopic parents are predisposed to the development of this disease. Hence they will almost certainly suffer from it if they are exposed to conditions which would be apt to engender near-sightedness in healthy eyes, free from any taint of hereditary tendency. We are therefore as a people threatened with an infinite increase of myopia, unless preventive medicine can devise some efficient sanitary precautions for counteracting the injurious effects of prolonged application in the school-room upon the visual organs of children.

Among the general conclusions arrived at by scientists for aiding in this object, so important to the rising generation, the following are worthy of especial notice :

In the first place, study-rooms should be well lighted during the day, and especially towards evening, because a feeble or badly arranged light compels us to diminish the distance between the eye and the book whilst reading or writing.

Light should be allowed to enter from the left side. Illumination from the front is more or less dazzling, and obliges the pupils to bend forward too much, or to sit sidewise in constrained and fatiguing positions. Again, light coming from behind is entirely insufficient, because in great measure cut off by the head and upper part of the body of each scholar.

The windows of a school-room should be large and high, and be arranged along the left side of the apartment, so as to shed the light upon desks placed in rows, at right angles to the wall in which the windows are cut.

The light from above, furnished by a skylight, is not so good as that derived from lateral illumination. The light of lamps is recommended as being preferable to gas, and the gaslight shining through ground-glass globes is condemned as being particularly objectionable. The inclination of the desk at which the pupil sits to read or write, is a matter of no small importance. Desks which are horizontal, or only slightly inclined, favor the development of myopia, by compelling the scholar to bend the head over a good deal whilst reading or writing. Such a position brings on, as a result of mere weight of the blood, passive congestion of the head and eyes, and this in turn results in an intra-ocular tension, insensible, perhaps, when it first appears, but very marked in its effects

when long and constantly continued. Besides, a child who acquires the habit of leaning forward in this manner, is very apt to bend nearer and nearer his book, as the muscles of his back become fatigued, and thus, by straining his power of accommodation at short focus, promote the rapid development of myopia. The desks of school children should therefore be sharply inclined at an angle of  $40^{\circ}$  or  $45^{\circ}$  when used for reading, and their seats should not be too high, and should be furnished with comfortable backs.

Great care should be taken to secure school-books well printed in large, clear type; since those printed in small, indistinct letters, upon bad paper, with poor ink, as is the case with too many of the classics and the dictionaries in common use, necessitate a close approximation of the eyes to the page, and consequently exaggerated efforts at accommodation, favoring myopia. Furthermore, all punishments of school children which consist in depriving them of recreation or exercise out of doors, or in adding to their amount of study, and consequent employment of the visual apparatus, should be relinquished.

The general principles which must be kept in view in the construction of seats and desks for school children, according to the investigations of Cohn and others, may be expressed as follows:

The faults of school furniture which give rise to injurious postures, and so conduce both to myopia and asthenopia, as well as to scoliosis or lateral curvature of the spine, are:

1. Want of, or unsuitable backs.
2. Too great a distance between the seat and the desks.
3. Disproportion, generally too great a difference between the height of the seat and that of the desk.
4. Wrong form and slope of the desk.

Dr. Liebreich gives a very clear exposition of the way in which these defects cause the diseases already mentioned, and concludes with the subjoined recommendations, which he considers, however, less advantageous than what he calls the American plan of having the seat and desk made to every child's measure, or the Swiss system, where seven or more different sizes of seats and desks are manufactured to suit the different classes:

1. One and the same size and model of desk should be used for children and grown-up persons of both sexes.
2. The adaptation to the height of each child should be effected by varying the height of the seat and the footboard.
3. The edge of the table is always to be in a perpendicular line above that of the seat.
4. No seat is to be without a back, and the top of this is always to be one inch lower than the edge of the table for boys, and one inch higher than the edge of the table for girls.

5. In all classes where the boys change places the height of the seat is to be regulated in proportion to the average height of the pupils.

6. In all girls' schools, in all those boys' schools where the children do not change places, in boarding schools, and in private school-rooms, the seat of each child should be accurately regulated in proportion to its height.

The support for the back should incline only a few degrees from the perpendicular, and be so arranged as to press upon the spinal column just above the hips of the pupil. The breadth of the seat should be considerable, in order to support most of the thighs, and its height just such as to allow the feet to rest easily upon the foot-board. The desk should be so arranged, by means of a hinged flap or otherwise, as to hold the book at an angle of  $40^{\circ}$  or  $45^{\circ}$  whilst reading, and the paper at an angle of  $20^{\circ}$  whilst writing is being performed by the scholars.

### ASTIGMATISM.

This term is applied to a defect of sight due to a difference in the curves of the cornea and crystalline lens in different directions; that is to say, the cornea, for example, may be so curved in the direction of a horizontal line through it as to have a focus of one inch, and be so much less curved on a perpendicular line that its focus in that direction is an inch and a quarter. The result of this different refraction, in different meridians of the globe of the eye, is necessarily an indistinctness of vision, because all the rays of light entering the eye from a bright point are not brought precisely to a point again upon the retina as they should be. This defect, which is found to be exceedingly common, especially in myopic eyes, can be very accurately corrected by the use of properly adjusted cylindrical glasses, which are so arranged as to distort the rays of light before they enter the eye just enough in a contrary direction, to cause them to be brought to an exact focus by the imperfect cornea and crystalline lens of the astigmatic eye. Spectacles giving this compensation ought to be procured and faithfully worn, not only because their use will tend to preserve the eyes, which would otherwise be apt to grow strained in the effort to make up for this defect by accommodating the lens, but also on account of the headache which is often the result of such constant effort to adapt the eye to clearer vision.

DAY-BLINDNESS is a term used to describe a disease in which the person affected can only see when the light is subdued, as in the twilight.

NIGHT-BLINDNESS, on the contrary, indicates a condition in which there is indistinctness of vision, except in a bright light. The causes of these two conditions are not very well understood, but night-blindness is known to chiefly affect those who have used their eyes too long and too steadily in a brilliant illumination or who have been exposed to intense or spark-



ling light. Rest is the chief means of cure, but prevention of these diseases by the proper protection of the organs of vision by colored glasses, or by the mechanical appliances mentioned when speaking of light is infinitely preferable.

### DISEASES OF THE LACHRYMAL APPARATUS.

The lachrymal gland, which supplies the tears, and is situated at the upper and outer angle of the eye, is subject to inflammation and the usual structural changes which result from that process. The most common disease, however, connected with the lachrymal apparatus is obstruction of the lachrymal duct or tube, which runs from the inner corners of the eyelids down into the cavity of the nose, and conveys the tears into the nasal cavity, which, under ordinary circumstances, they merely serve to keep comfortably moist. This obstruction may occur from inflammation of the lining membrane of the duct caused, perhaps, by cold, and if neglected it frequently runs on to abscess, which requires a surgical operation to remedy its effects. Commencing inflammatory action affecting the duct may be treated with anodyne lotions, such as the lead-water and acetate of morphia solution recommended in erysipelas, but if relief is not promptly obtained a skilful oculist ought to be at once consulted.

### DISEASES OF THE EYELIDS.

The most common of these is the little boil at the edge of the lid, called hordeolum, or popularly a sty, which can be benefited by poulticing, but not enough, as a rule, to compensate for the trouble and obstruction to vision thus produced. Turning in and turning out of the eyelids, the latter the result frequently of burns about the face, require surgical operations for their relief. Trichiasis is the name for that growing in of the eyelashes, commonly known as wild hairs in the eye. These hairs, occasionally a single one at a time, by rubbing upon the sensitive cornea whenever the patient winks, may cause much irritation and even injury to the sight. The trouble can be obviated temporarily by pulling out the offending hairs with small tweezers, if they can be detected in a bright light, but often a surgical operation is also necessary in this affection to accomplish a permanent cure.

### STRABISMUS OR SQUINTING.

This disease is the commonest of the derangements of the eyeballs within their orbits. In it the eye is involuntarily drawn from its straight position to one or the other side, so that the natural and agreeable parallelism of its axis with that of its fellow is not maintained. When the eyes

are turned in towards the nose, as is the more commonly the case, the strabismus is called *convergent*, and when the squint is outward, it is spoken of as *divergent* strabismus. This defect is due either to shortening of one of the six little muscles by which the eyes are moved in their sockets, or to the spasmodic contraction of one of these muscles, or to paralysis of one of them and relative over-action of its natural opponent. Strabismus is in some cases an acquired affection, and may even result from the bad habit among children of imitating deformities of this kind. More frequently it appears to be the product of hereditary tendency. It may affect both eyes in the same person, and even in the same direction, and is then called double strabismus, or it may be confined to one eye, the other remaining perfectly healthy. Something can be done in the treatment of this malady when it first commences in children who are not too young to wear spectacles by having these arranged with half pieces of black glass, so that the patient is compelled to look straight forward. But the simple operation of cutting through a part or the whole of the contracted muscle is in suitable cases the best remedy, and often, not always, proves perfectly successful in removing the deformity.

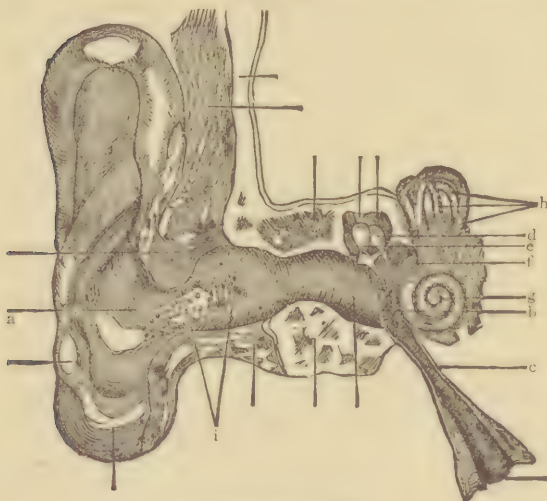
### DISEASES OF THE EAR.

The number of diseases of the ear is twenty-four, but as a majority of them require for their recognition and effective treatment more or less peculiar and costly apparatus, only a few of the most important require notice in this chapter. For the understanding of these, however, a brief

review of the anatomy of the ear is necessary.

The external ear, or auricle, as anatomists call it, is supposed by many people to be the chief part of the organ of hearing, but in reality the essential pieces lie inside the head, some, indeed, imbedded in the most solid bone of the skull, and one is so hard that it has received the name of the *petrous* or rocky portion of the temporal bone. Besides the auricle, which is all that portion of the ear projecting from the head, the external ear is considered by anatomists to include the auditory canal (a), or

FIG. 36.



SECTION OF RIGHT EAR.

that portion of the ear projecting from the head, the external ear is considered by anatomists to include the auditory canal (a), or

opening into the head, and the delicate tympanic membrane or drum-head (b), which is drawn across the auditory canal like a curtain, at a depth of about one inch and a quarter from the outside. The middle ear, as it has been named, called also the drum of the ear, is bounded outwardly by the tympanic membrane, and inwardly by the bony portion of the labyrinth or internal ear. It includes the Eustachian tube (c), which is a fleshy pipe, communicating through the head with the upper and back part of the throat, and it contains the ossicles or little bones of the ear (d, e, and f). These ossicles are three in number, and are named from their resemblance to the familiar objects after which they are called—the hammer (d), the anvil (e), and the stirrup (f). These remarkable little bones play a curiously elaborate part in the mechanism of hearing. The chief portions of the internal ear, or labyrinth as it is often called, on account of its perplexing structure and function, are the cochlea or snail-shell (g), and the semicircular canals (h). The appearances of these are sufficiently indicated by their names, and their positions can be best understood by looking at the picture upon the preceding page.

The object of the auricle in man is to collect the waves of sound, just as the broad mouth of an ear-trumpet does, and it seems to have no other duty in the process of hearing. In order to prevent, as far as possible, the entrance of insects with the sound-waves into the auditory canal, the exterior opening of this tube is guarded by stiff, coarse hairs. It is also generally covered with a sticky, bitter substance, the ear-wax, secreted by numerous ceruminous glands (i), apparently to stop, or disgust, any adventurous creatures which may attempt to make their way in towards the drum. This provision is highly necessary, because the tympanic membrane is so exceedingly sensitive that a very slight touch, even from the foot of a small insect, would cause intense pain. On account of this great delicacy of the membrane of the drum, it is unsafe to put any hard object into the ear for the purpose of cleansing it. Hence, the corner of a towel is far better to wipe out the ear with than an earpick or any other solid instrument. Sometimes a firm plug of wax accumulates in the external auditory canal, and causes deafness, which, however, can be entirely and immediately cured if the hardened wax is removed by syringing with warm water. When children put beads, grains of corn, and so forth, into their ears, no attempt should be made to pick them out with hair-pins or bodkins, lest, on the contrary, they be pushed further down the tube. It is much wiser to send for a physician, who is provided with suitable, delicate forceps, for removing them without risk of such a serious addition to the original misfortune. If an insect makes its way into a person's ear, notwithstanding nature's safeguards against such an accident, the patient should at once lie down on the opposite side and have the affected ear filled up with sweet olive oil, which will probably kill the creature and cause it to float up to the mouth of the auditory canal,



where it can be picked out. The office of the auditory canal is to convey sounds, after they have been collected by the auricle, to the drum-head, which is caused to vibrate just as that of a soldier's drum does when it is beaten, or rather as the sounding-board of a piano does when the keys are struck. The vibrations thus produced are transmitted along the chain of ossicles, that is to say, the handle of the malleus or hammer, being fastened to the tympanic membrane, moves with it. In thus moving, it tilts the incus or anvil slightly over, and this motion of the anvil in its turn causes a slight oscillation of the stapes or stirrup. But the stirrup is fastened by its foot-plate to the membrane covering a little hole in the bony wall of the labyrinth, called the oval window, so that any vibration of the drum-head or tympanic membrane is carried along over this chain, or bridge of bones, to the covering of the oval window. Behind this latter membrane the whole labyrinth is filled with a watery fluid, which bathes the terminations of the auditory nerve in the cochlea. The exact use of the semicircular canals is not understood, but there is little doubt that the fine hairs proceeding from cells found in the cochlea, are thrown into vibrations by undulations transmitted from the membrane of the oval window through the fluid contained in the cavities of the labyrinth. Then these vibrations of sound are perceived by the delicate nerve-fibres, in which the auditory nerve terminates, very much as the undulations which constitute light and color are perceived by the filaments of the optic nerve, where they terminate in the rods and cones of the retina. Obviously, with such a complicated and excessively delicate mechanism for carrying on the process of hearing, the wonder is, not that few people hear imperfectly, but that everybody is not as deaf to all sound as the world has been in previous ages to the teachings of hygiene.

#### DISEASES OF THE AURICLE OF THE EAR.

This outer part of the ear is the occasional seat of gouty and other deposits, which give rise to prominences and irregularities of its surface; it may also be affected with a kind of vascular tumor called hæmatoma, and still more frequently be the seat of benignant and malignant or cancerous tumors, and of various malformations. In persons of slight and delicate organizations, with a scanty stock of vitality, the outer ear is often exceedingly small, although it may be perfectly shaped. In persons of large build and actively circulating blood, the auricle is sometimes relatively large, the lower lobe being pendulous and of exaggerated development. As a rule, a large lobe of the ear indicates a free vascular supply of blood to the brain, and is said to be to some extent a sign of epilepsy, and of other kindred nervous diseases. If people choose to run the risk of suffering from the dangerous little tumors which are sometimes caused by the barbarism of wearing ear-rings, they should be very

careful to diminish the chance of injury as much as possible by having the auricle pierced with a clean, bright instrument, and by preventing the cartilage, which sometimes comes quite low down in the lobe of the ear, from being wounded. Children should never be punished by "boxing" or pulling the ears. The former piece of brutality might instantly burst the tympanic membrane, causing deafness for life, and the latter is liable to originate severe inflammation of the auricle, leading to the same unfortunate result.

### DISEASES OF THE AUDITORY CANAL.

The most important affection of the external meatus of the ear is abscess, which is one of the most painful minor maladies flesh is heir to. It is in reality a minute boil in the ear, but is rendered so frightfully painful by the fact that it is shut in between a layer of strong cartilage and solid bone. Probably the most common cause of abscess in the ear is taking cold, although picking the ears with hard, sharp instruments sometimes seems to excite it. As it is impossible to tell which side of the auditory canal the pus of the little ball is beginning to form, no certain benefit is derivable from lancing the swelling, and, as a rule, all that can be afforded in the way of relief, is gained by hot poultices made out of ground flax-seed, bread and milk, or little bags of hops dipped in hot vinegar, and changed very frequently, or as soon as they grow cool. In the mean time some respite and sleep may be obtained by the use of opium suppositories containing one grain each used every four hours, or hypodermic injections of one-eighth to one-half of a grain of morphia, during the time it takes for the abscess to ripen and discharge, which is generally from three to eight days, or rarely longer. As these boils in the the ear have a tendency to appear one after the other, either in the same ear or its fellow, it is advisable to make an effort to cut off the succession by full doses of quinine, which ought to be continued in quantity sufficient to produce slight cinchonism or ringing in the ears, which requires from eight to twelve grains for at least ten days after the first abscess is entirely cured. The hearing, whilst the swelling accompanying an abscess continues, is lost, and it often remains imperfect on the affected side for one, two, or three weeks afterwards, but no apprehension need be felt in regard to its ultimate restoration.

Polypus of the external auditory canal is a soft and sometimes very vascular growth within the meatus, and often attached by a broad base to the mucous lining. When once formed, it is apt to grow rapidly, and become quite painful, keeping up a continual irritation and discharge, with deafness of the affected ear. A surgical operation is needed for its cure.

An exostosis or bony tumor occasionally springs up from the walls of

the auditory canal, pushing the mucous lining before it, and filling up part or all the calibre of the tube. This growth, until chiseled away, is sometimes very painful, and a serious obstacle to the hearing. It is most frequently met with in people of a rheumatic or gouty tendency.

### DISEASES OF THE TYMPANIC MEMBRANE OF THE EAR.

Inflammation of the drum-head is an acutely painful affection, sometimes attended with fainting fits in its early stages, and usually resulting in deafness because the membrane is left thickened, and therefore incapable of properly responding to the vibrations of sound. Leeching, followed by blisters behind the ear, or on the nape of the neck, and a strong solution of morphia in glycerine dropped into the ear, with opium internally or hypodermically, to mitigate the suffering, which is often very severe, constitute the treatment. As a result of inflammation, ulceration of the mucous surface of the tympanic membrane occasionally takes place, and is apt to leave the drum-head contracted, so that permanent deafness remains.

Perforation of the tympanic membrane is especially liable to occur during the course of scarlet fever, from suppuration of the middle ear, and if neglected, as already mentioned, leads to permanent deafness. Hence, in scarlatina, the ears of a child should be carefully examined daily with the little conical mirror called an ear-speculum, if there is the slightest complaint of pain in them, in order to prevent this disaster by an early puncture of the drum-head, which allows the escape of the imprisoned pus, and so saves the organ of hearing. Still, when a permanent opening or perforation is left in the tympanic membrane, the auditory sense, though impaired, is not entirely lost, and this defect is at times lessened by the accumulation of wax over the opening, and can often be greatly improved by that ingenious little contrivance, an artificial ear-drum. In diseases where the mucous membrane of the throat is implicated in inflammatory processes, the inflammation is apt to spread from the pharynx along the Eustachian tube, and so produce what is called throat-deafness, for which attention to the throat malady is necessary.

Thickening and condensation of the tympanic membrane are liable to occur in advanced life, the delicate skin forming the drum-head undergoing a slow process of change, by which it loses its elasticity, and becomes firm and hard almost like the nail of the finger. Of course, in this condition the vibrations into which it should naturally be thrown, are rendered very imperfect, and the hearing is correspondingly defective in old people who are the subjects of this degeneration.



### DISEASES OF THE EUSTACHIAN TUBE.

The Eustachian tube is liable to inflammation from extension of disease from the throat, even such a simple irritation as that of a common cold. It is also subject to obstruction and contraction, so that the air cannot pass freely through it into the cavity of the tympanum, as it should do in health. When this takes place, the vibration of the drum is interfered with, there is pressure within the cavity, and consequently a sense of fulness and deafness is experienced, which is very oppressive. This distressing condition can often be greatly relieved by calling in a skilful aurist, who may pass a probe or hollow tube along the Eustachian canal into the middle ear, and so restore the communication of the latter with the external air.

Diseases of the middle ear and of the internal ear comprise inflammation, ulceration, and abscess. All these are very painful, difficult to recognize with certainty, and, as a rule, beyond the power of any but the most skilful treatment. In every case an experienced aurist should therefore be immediately called in, and until he arrives the severity of the pain may, perhaps, be held in check by some of the means suggested when speaking of abscess of the auditory canal.

### DISEASES OF THE NOSE.

The organ of the sense of smell is much more extensive than people who have never studied anatomy imagine. Instead of being merely a triangular projection of some two or three inches long, and an inch or an inch and a half high, occupying the middle of the face, it is a large double cavity reaching far back into the head, and communicating by the posterior nares or hinder nostrils with the upper part of the throat. The external portion of the nose is composed at its upper third of small bones, which are continued at its lower part by plates of cartilage. These cartilages and bones are covered on the outside with a thin skin, and on the inside with a mucous membrane, which in the deeper recesses of the cavity is identical and continuous with that of the mouth and throat. The external division between the two nostrils is carried upward and backward by a flat, very thin bone named the vomer; and the sides of the two cavities, which are continuous with the exterior nostrils, are partly filled up with soft, spongy processes of bone, three of which are called the turbinated bones, because they are rolled up like a scroll. These turbinated bones are covered, like the rest of the nasal cavities, with a mucous membrane, named the Schneiderian membrane, richly supplied with blood-vessels, which approach very near its soft and delicate surface. It is from these small, but active, little blood-vessels that the hemorrhage usually comes in bleeding from the nose. Ordinarily this inconvenient accident

is only troublesome, and if it continues too long can be stopped by simply applying ice to the sides and root of the nose, or stuffing up the nostril the end of a roll of rag or strip of sponge which has been dusted with powdered alum. In very obstinate cases, such as occur in the course of typhoid fever, purpura, heart-disease, and so forth, it may be necessary for the physician to plug up both the anterior and posterior nostrils by the aid of an ingenious little instrument which has been devised for the purpose. The nerves of smelling, called the olfactory nerves, enter the upper part of the nose through openings in the sieve-like bone, which forms the roof of the nasal fossa. After passing into the nose, these olfactory nerves divide up into a great number of tiny branches, which run along under the surface of the Schneiderian membrane, and are spread out upon the superior and middle turbinate bones, and on the sides of the partition between the two nasal cavities. The great use of the turbinated bones and processes is to furnish a large extent of surface upon which these branches of the olfactory nerve can be expanded. And this spreading out of the olfactory nerve is evidently in order that the sensitive filaments may, on occasion, come in contact with as large a number as possible of the exceedingly minute, odorous particles which many substances, such as musk or camphor, are constantly giving off in such abundance. These odorous particles have the power of affecting the terminal filaments of the olfactory nerves in different ways, which we recognize as the agreeable or disagreeable odors of the objects from which they originate. The excessive minuteness of such particles may be comprehended from the fact that the apartment of the Empress Josephine in one of the French Imperial palaces was found, after twenty-four years of disuse, to give off a distinct odor of the musk employed by that unfortunate lady when she occupied it.

The power of distinguishing odors, which to some animals, including all those beasts which pursue their prey by scent, is one of the most vitally important, chiefly serves as a means of gratification or its opposite to human beings. But although the sense of smell does not in civilized communities contribute anything towards sustaining life by helping us to secure food, it has a very useful hygienic office, which should never be forgotten, in guarding us against some of the most common and dangerous causes of disease, in foul air and polluted water. Besides this the nose has an important work to do in warming and, to some extent, purifying the air we breathe, as that air is drawn through the narrow and winding passages among the turbinated bones. The Schneiderian membrane over which this air passes being generally moist, and more or less covered with adhesive mucus, helps to catch not only the odorous particles, but larger and more hurtful impurities, and so is quite mechanically a valuable protector to human health.

Among the important diseases of the nose should be mentioned hyper-



trophy, an affection in which the skin and subcutaneous cellular tissue are increased in bulk, the cutaneous surface becoming vascular and mottled. It is a common result of indulgence in stimulants, and though only important from a medical point of view in itself as a deformity, it is often a serious sign of far more dangerous changes in vital, internal organs from the same poisonous effects of alcohol.

Warts upon the nose sometimes give needless alarm on account of the suspicion that they may be the commencement of cancer. This anxiety should be relieved as soon as possible by consulting an experienced surgeon, and if he advises it, by the prompt removal of the little tumor, in accordance with the suggestions made in the article on cancer upon page 384.

Acne rosacea is an affection of the skin of the nose, usually the result of alcoholic indulgence, and causing redness of the point of the organ, enlargement of the veins, and an eruption of small pimples or tubercles, ending in thickening and minute scars. Like hypertrophy from the same cause it is chiefly important as an indication of similar changes which are going on at least as rapidly in the liver and kidneys, and will be very apt to lead to prolonged painful illness and premature death.

Ozena is a painful and disgusting affection in which there is a persistent fetid discharge from the nose, very apt to last for months, and even years, before it can be cured. The disease is usually dependent upon the death and decomposition of portions of the spongy, turbinated bones of the nasal cavity; it is sometimes produced without any apparent cause, as if from something imperceptibly inhaled which excited ulceration, but in many instances ozena depends upon a scrofulous or syphilitic taint which may be inherited. In such cases the treatment must be directed to the constitutional disease, but whilst administering anti-strumous or anti-syphilitic remedies much can be done to render the unfortunate patient less offensive to those who come near him by the employment of disinfecting lotions, such as weak solutions of carbolic acid ten drops to the ounce of water or permanganate of potash, which should be introduced to the diseased spot by careful syringing several times daily.

Polypus of the nose is another very distressing affection, consisting in the development of a large, soft growth within the nasal cavity, creating great obstruction. There are two varieties of polypus, the gelatinous or jelly-like, and the fibrous, which is of slow development and relatively firm consistence. The treatment is by tearing away the growth and cauterizing its root, which should always be done early, as if neglected these new formations may become very large and troublesome.



## CHAPTER IX.

# DISEASES OF THE CIRCULATORY AND ABSORBENT SYSTEMS.

THE most important of the affections treated of in this chapter are those of the heart and great blood-vessels, situated in the thorax or upper part of the trunk. They are recognized in part by the local and general symptoms, but chiefly by the physical signs of auscultation and percussion. The great discovery made early in the present century by Lannec, that we could in this way determine the condition of the heart and lungs within the living body, has almost revolutionized the practice of medicine. In no department, however, is more absolutely necessary the trained skill of an expert with the stethoscope than in diseases of the chest, and therefore little space will be occupied in these pages with references to the physical signs which can only be appreciated by an experienced auscultator.

As matters of general information it may be stated, however, that auscultation is the technical term applied to the act of listening, either by a short trumpet-shaped tube called the stethoscope, or with the naked ear applied to the chest, to the sounds of the heart, lungs, and great blood-vessels. The sounds of the heart, as already explained, being made in great measure at least by the closure of the cardiac valves, indicate by the slight modifications they undergo certain well-defined changes produced by disease in the valves themselves. In encountering diseases of the lungs we also derive much aid from auscultation, which shows differences in the sound of the air-currents during breathing, coughing, or speaking, as they pass along the bronchial tubes into the air vesicles, according as these latter are narrowed by inflammation, obstructed by secretion, or as the sound is conveyed through spongy or condensed lung structure. Still more information may be gained in many instances by percussion or tapping upon the walls of the thorax, and judging not only of the character of the sound elicited, but also of the resistance yielded to the blow. Familiar applications of the principle involved are made by brewers who tap on a cask partly filled with beer and so determine with much accuracy the height of the fluid, or by carpenters who knock upon a partition to

find out just where to drive a nail into a beam of wood. It is really astonishing what skill some workmen will acquire by long practice in the use of these and similar tests, and the same kind of training gives an experienced physician a vast advantage in judging of the nature, stage, and progress of thoracic disease.

Any attempt to manage a malady of this kind without the aid of auscultation and percussion, puts the patient in the unfortunate position of those who lived in past ages of the world, when blind guesses were often the best attainable guides in the treatment of diseases of the heart and pulmonary organs. These wonderful improvements in medical science, like the steamship and ocean telegraph in commerce, have enabled us to substitute precise knowledge for ignorant speculation.

In making a thorough examination of the soundness or unsoundness of organs within the chest, its surface should be fully exposed before and behind. Neither auscultation nor percussion can be satisfactorily performed through the ordinary clothing, or in obscure cases, indeed, through clothing of any kind, except it be a single garment of the thinnest possible texture which females may be permitted to wear to avoid the appearance of indelicate exposure. The physician and the person examined should be placed in positions of the least muscular restraint for both. The examiner ought not to stoop nor bend his head over too much. The person being examined may stand upright, with the arms hanging by the sides, when the front of the chest is being explored, whilst sitting on a stool, stooping forward with each hand grasping the opposite shoulder, is the best posture for an examination of the back of the thorax.

There are few complaints which more surely tend to shorten life, and none give rise to greater suffering and distress, than diseases of the heart, its pericardium, and the great vessels which emerge from it. In both young and old they are the chief causes of sudden death, and if not abruptly fatal they lay down, as remarked by Sir Thomas Watson "their own hard conditions for the continuance of a man's life, and almost settle beforehand the manner of his death."

### GENERAL SYMPTOMS OF HEART DISEASE.

The general symptoms which indicate disease of the heart and its appendages, are, beside the expression of the countenance, palpitation, faintness, difficulty of breathing, and sometimes cough and pain over the cardiac region.

The countenance is often very expressive of heart disease. In acute inflammations of the lining or the investing membrane of the heart it acquires a depressed and anxious character. A movement of the sides of the nostrils is commonly observable with each effort at breathing, and the occurrence in young children, who cannot explain their feelings, of

these two symptoms often indicates a greater amount of disease than the general condition would lead us to suspect. In chronic cases of heart disease the expression of the face becomes almost unmistakable. The venous system being congested, the countenance appears bloated and dusky, the eyelids puffed, the eyes themselves staring and blood-shot, the lips and cheeks purple, the respiration laborious, the air-passages loaded with mucus, and the jugular veins distended or pulsating. The sensation of dyspnœa or difficulty of breathing is brought about by embarrassment of the respiration, and amounts in severe cases to a sense of suffocation; it is aggravated by muscular exertion, by certain positions of the body, and by a full stomach. The act of speaking is frequently interrupted to fetch a breath, as it is popularly called, and the patient who suffers from dyspnœa cannot hold the breath, or refrain from the attempt to inspire, as a person in health is able to do. The dyspnœa may occur in paroxysms, and the acts of respiration themselves may be painful. The dyspnœa of disease of the heart is quite different from that of asthma, oppression rather than tightness is complained of, with a strangling, choking feeling about the throat. The breathing is always quickened and the dyspnœa is most intolerant of movement, or of any exertion whatever. So long as quiet is maintained the interference with breathing may not be troublesome, but the moment any effort is made the breath is gone. It is no less intolerant of the recumbent posture. Hence arises orthopnœa or upright breathing, the patient being compelled to sit or even stand erect in order to breathe, so that in extreme cases he may not be able to lie down for weeks, or even months. In such instances of terrible suffering the unfortunate man if he should fall into a doze may be almost immediately awakened by a feeling of impending suffocation, and he instantly commences in his horror what may really prove a death-struggle for breath.

Palpitation is defined as the conscious sensation of the excited action of the heart, and is a common symptom in both functional and organic, that is, structural cardiac disease. It varies from a mere feeling of fluttering to agitation of the most distressing violence. It must be remembered that the amount of distress is no safe guide, either as to the real force of the heart's action, or as to the condition of the organ itself. In all cases, it is the expression of the nervous irritability of the system, which may be only in very small part dependent upon actual cardiac disease. It frequently occurs in dilatation or over-swelling of the heart, and in cases where the muscular substance of the heart is ill-nourished. Under these circumstances, it indicates a demand upon the organ for work in excess of its powers. In other instances, it may be due to irritation in the brain, hysteria, emotional excitement, or the abuse of tea, coffee, alcohol, or tobacco, and so forth.

Irregularity may affect either the succession, or the force, of the heart-beat. It more commonly arises from some change in the substance of



the heart, connected with impairment of its working power. It generally comes on, sooner or later, in all the serious forms of cardiac disease, and marks the time when the actual substance of the heart begins to degenerate. This degeneration is frequently associated with the gouty diathesis or predisposition. The action of the heart is sometimes intermittent, and the more common form of this functional disturbance is characterized by a series of imperfect heart-beats, occurring every now and then, which may be quite insufficient to cause a perceptible pulse-wave in the arteries. It indicates a more advanced degree of cardiac weakness than irregularity alone.

The term, cyanosis, is applied to a condition in which there is more or less blueness and lividity of the skin, the result of venous congestion and imperfect aeration of the blood. Hence, it is a common symptom in valvular disease of the heart, and is also seen in bronchitis, emphysema, and cholera. In its worst form, it is usually the result of malformation of the heart. The color is most marked about the lips, nose, ears, ends of the fingers and of the toes, and these portions of the body are usually below the natural temperature.

### PERICARDITIS.

Pericarditis is an inflammation of the membranous bag in which the heart is enclosed, and is not very infrequently an accompaniment of acute rheumatism, or of Bright's disease. In rheumatic pericarditis, one of the most marked characteristics is pain in the region of the heart, often extending over the whole of the breast-bone and down the left arm. It is frequently accompanied by disturbance of the heart's action, a sense of constriction over the whole chest, and an incapacity to take a long breath or to cough. In many instances the restless and anxious expression of the patient's face is peculiar and striking from the first. If the disease continues for some days unsuspected or unrelieved by treatment, there is usually watery effusion around the heart, causing, by its pressure upon the organ itself, feebleness and irregularity of its motions, great pain, and difficulty of breathing, often terminating in death. There is frequently a short, dry cough, and the pulse may be increased very much more in proportion to the breathing than is usually the case in fever. It is also liable to sudden variations from slight causes. In some instances, all the signs of inflammation about the heart are absent, and the first suspicion of the serious cardiac trouble is aroused by the sudden death of the patient. The action of the heart in these rare cases may get feebler and feebler, the pulse becoming irregular and then intermittent, the veins in the neck prominent, the skin cold and pale, and soon after the appearance of dropsy, death results from the unrecognized malady.

On auscultation, in the early stage of this disease, there is generally

heard a rubbing sound, made by friction of the two inflamed and roughened surfaces of the pericardium. By percussion, as the stage of effusion comes on, the increased surface of dulness, triangular in shape with apex of the triangle above, can readily be detected.

*Treatment.*—The treatment consists of leeching, if the patient is strong enough to bear the loss of blood, and if not, the application of a blister over the outer side of the chest, above and to the left of the seat of most severe pain. The suffering and distress may be controlled by opium, or morphia hypodermically, in one-eighth or one-quarter grain doses; and in the rheumatic form, extract of colchicum, one grain every four hours, with large doses of the alkalis, such as twenty grains of the bicarbonate of potash every four hours, should be employed. Where the effusion into the heart-sac is very great, and death seems imminent from pressure interfering with the action of the organ, the fluid ought to be aspirated, that is, drawn off through a perforated needle, by means of a suction-pump. Although this operation is not without danger, occasionally itself causing the loss of life, yet in some cases it is right to accept this risk, for the sake of the chance of immediate and welcome relief which it sometimes affords.

One of the results of pericarditis is the adhesion of the two layers of the membrane together, either wholly or in patches of greater or less extent. These adhesions constitute very serious interferences to the due action of the organ, as will readily be understood. Besides these impediments to functional activity, the organized lymph which forms the bond of union, is apt to be in after years the seat of deposit of a bony or chalky substance, which still further obstructs the proper performance of the cardiac functions, and is very apt to lead to fatty degeneration of the muscular substance of the organ.

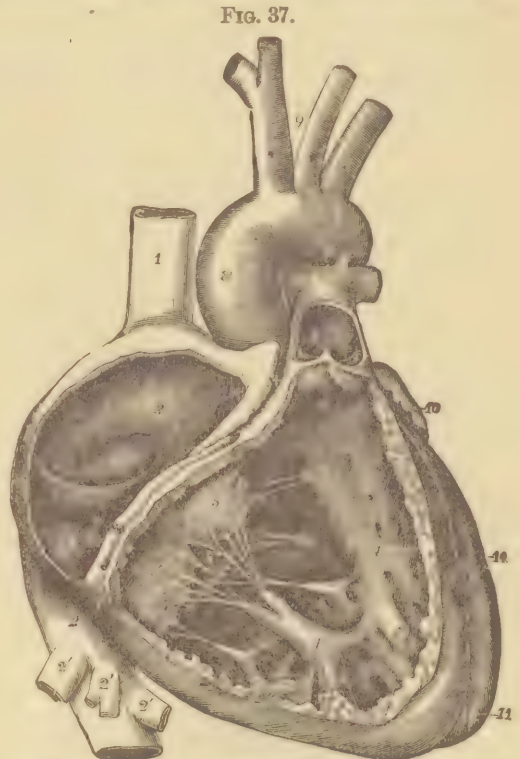
Dropsy of the pericardium is the accumulation of watery fluid in the cavity of the membrane around the heart. It may either be, as already explained, the result of inflammation, or may occur in general dropsy, and prove suddenly fatal by compression of the heart and mechanical stoppage of its movements. In urgent cases, it should be drawn off by the aspirating needle, as advised above.

### ENDOCARDITIS OR INFLAMMATION OF THE MEMBRANE LINING THE HEART.

This form of disease is much more frequently met with than pericarditis, and probably occurs to some extent in nearly all cases of acute rheumatism. It is also apt to develop during the course of Bright's disease, particularly the form which appears after scarlet fever. In both instances, it is apparently the result of the irritating influence of the poisoned blood as it flows over the valves in going the round of the cir-

ulation. The course of the blood in making this circuit has already been described, but it may be well to point out to the reader how readily, as shown in the marginal illustration which exhibits the valves of the right side of the heart, fibrin, which forms upon threads of any kind, would be apt to be deposited on the heart-strings which partly compose the tricuspid (5) and mitral valves.

The first effect of inflammation is to roughen the endocardium, and very soon granulations or vegetations occur, particularly upon the edges of the valves of the left side or left heart, namely, the mitral and the aortic valves. After the disease comes to an end, these vegetations, unfortunately, do not disappear, but remain, in many instances, as little lumps of organised fibrin, which in subsequent years contract, harden, and may have deposited in their substance a chalky or bony material. The most common ultimate effects are, first, thickening and puckering of the valve segments or leaflets (such as



CAVITIES OF THE RIGHT SIDE OF THE HEART WITH THEIR VALVES.

are shown in the pulmonary valve at 4 in the figure); second, adhesion of the valve segments to each other; third, thickening, shortening, and glueing together of the tendonous cords of the valves, commonly called the heart-strings (5); fourth, narrowing of the orifices; and fifth, formation of large, fungous-like growths, from the continued deposition of fibrin out of the blood, upon the granulations. These changes, which, small as they are, cause so much and such terrible suffering, constitute the anatomical basis of valvular disease of the heart, which will be considered in the next article.

The common symptoms of endocarditis are discomfort and uneasiness about the region of the heart, with palpitation. At first there is often febrile heat of the skin, with increased force and frequency of the pulse, but after the fibrinous effusion takes place the interference with the natural action of the heart is frequently so considerable that the pulse and heart-beat become small and soft. The most important guide to the occurrence of endocarditis is the change in the heart sounds, which assume a rough



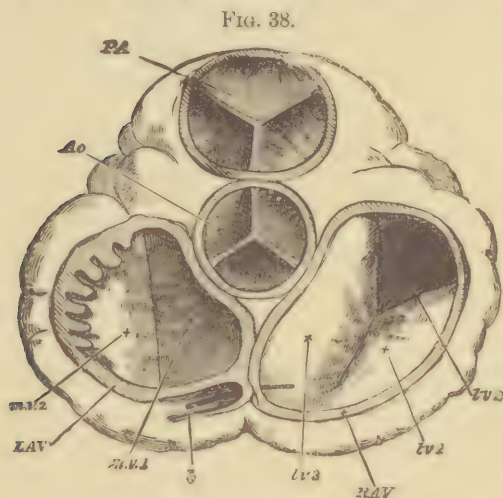
or rasping character, due to the friction of the blood as it flows over the vegetations on the edges of the valves. The products of the inflammation are liable to poison the blood, giving rise to many of the symptoms of pyæmia.

*Treatment.*—The treatment of this malady is similar to that of pericarditis, but after the acute stage has passed, the administration of iodide of potassium in five-grain doses with bitter tonics, such as a teaspoonful of compound tincture of Peruvian bark or of gentian, thrice daily, is important.

### CHRONIC VALVULAR DISEASE.

Chronic disease of the valves of the heart usually arises from endocarditis connected with rheumatism, but may originate in fatty or chalky degenerations, or in enlargement of the orifices, the result of dilatation of the heart. The physical results of valvular disease are, first, insufficiency, which being due to a disproportion between the size of the orifice to be closed and the leaflets of the valves to close it, gives rise to a regurgitation or leaking back of some of the blood; the second variety of evil result from valvular disease is that of obstruction, which is owing to a partial narrowing or blocking up of the orifice, so that less blood than naturally passes in health can get through. Each of the four valves of the heart is liable to be the subject of either of these defects; that is to say, any one of them may close so imperfectly that some blood leaks back or regurgitates, or it may be so narrowed by disease as to obstruct the flow of blood and prevent the full amount of that vital fluid passing through

it. Either of these conditions must obviously have very seriously injurious effects upon the health of the person in whom they occur. As, however, these effects often come on very slowly, so that the patient gradually in the course of years grows accustomed to them, it is astonishing what a vast amount of change in the formation of the valves can occur without destroying life, although the amount of suffering produced is frightful to contemplate. The mechanism of



BIRD'S-EYE VIEW OF THE VALVES OF THE HEART.

the interference to the proper action of the heart valves, produced by the vegetations or perforations left after endocarditis, will, perhaps, be better understood by reference to the accompanying figure. This illustration represents a hardened section of the

heart, cut transversely across the organ so as to show how the pocket-like valves come together in the middle of the openings in order to close those orifices. At L A V are seen the two flaps of the mitral valve, which shuts off the return current of the blood as it is being driven by the strong left ventricle into the aorta, and at A O are depicted the three flaps of the aortic valve, which is closed by the return current of the blood from the great aorta after it is pumped into that large blood-vessel by the ventricular contraction. It is plain to be seen that if the edges of these valves are rough, or ragged, or perforated, they cannot shut tightly and, like a pump-valve which is worn out or has a bunch of grass stuck fast in it, will allow some leakage to occur. Unfortunately the valves of the heart, unlike those of a pump, cannot be taken out for renewal or repair, or even for cleansing, so that the imperfect action and its evil consequences must go on in the human system, often from bad to worse, until frequently, after horrible suffering, it destroys the life of the individual.

The common forms of valvular disease of the heart, found perhaps in every tenth man you meet, are those affecting the mitral and aortic valves. Disease of the tricuspid and pulmonary valves belonging to the right side of the heart are rare, except as secondary complications of valvular disease on the left side. The diagnosis of valvular disease of the heart is almost always difficult without the aid which auscultation and percussion afford to an expert physician.

Mitral regurgitation is one of the most common valvular affections, and being the frequent result of acute rheumatism is often met with in early adult life. The alterations of the valve consist in the thickening, puckering, and stiffening of the flaps, as already described, in consequence of which they fail to close tightly and allow five, ten, or perhaps twenty per cent. of the blood to leak back into the left ventricle, instead of being sent on through the aorta to go the round of the circulation. For a time nature often compensates for this failure by making the left ventricle proportionately stronger, that is by causing a hypertrophy of the ventricle so that it can pump out five, ten, or twenty per cent. more blood, and so exactly counterbalance the leak. During this period, as long as the patient keeps well in other respects, there may be no suffering at all from the valvular disease, or perhaps only a slight difficulty of breathing is experienced, on making unusual exertion, yet all the time the valvular disease is there, and can usually be detected by careful auscultation. After middle life, if not before, however, there comes a time when the hypertrophy ceases to progress, and then the left ventricle begins to be over full and oppressed by the blood which leaks back into it, and which it can no longer fully empty out at each stroke. This produces a swelling or dilatation of its cavity, in which the blood is more or less dammed up. Of course, this damming up of the blood rapidly extends into the left auricle and from it along the pulmonary veins into the lungs, there caus-



ing feelings of oppression and difficulty of breathing. If not relieved this damming up process extends still further to the right side of the heart and through it to the venous system, which becomes in turn overloaded. Hence the symptoms of venous congestion observed in advanced valvular disease of the heart, such as blueness of the lips, dropsy of the ankles, legs, and finally of the whole body. In consequence of the pulmonary congestion, cough with abundant watery expectoration usually comes on, and adds to the agonizing suffering. Without describing in detail the results of the other forms of valvular disease, it may be sufficient to state that although varying in the order in which they develop the general symptoms resemble in many respects those of mitral regurgitation. Important differences are met with, however, in the pulse, and in the effects upon the head and stomach, for in aortic regurgitation the pulse is often strong, hard, and quick in its stroke, whilst the pulse of mitral regurgitation is apt to be soft, feeble, and intermittent. In the former variety of the malady, headache and other evidences of cerebral congestion are prominent, whilst in the latter dyspeptic symptoms are apt to be troublesome. The most dangerous form is aortic regurgitation, from which sudden death is no unusual result. Mitral regurgitation, mitral obstruction, and aortic obstruction, are in the order named less immediately dangerous, and death, when it does come, is attended with the doubtful advantage of a more gradual and long-suffering failure of vitality.

*Treatment.*—Since we can neither replace nor repair the damaged valves of the heart, the principles of treatment for chronic valvular disease are, first, to reduce the work the heart has to do as much as possible by instructing the sufferer to avoid all unnecessary physical and mental effort; second, to develop the remaining powers of the crippled heart, for accomplishing its work, to the highest possible point, by the aid of tonics, the most nutritious food, and especially by securing rich and healthy blood. When, in spite of this kind of judicious management, indications of commencing dilatation of the heart appear, much benefit can often be derived from ten drops of the tincture of digitalis thrice daily, under the action of which the irregular or intermittent pulse grows stronger and more steady, and the other symptoms improve sometimes to a very marked degree. Occasionally digitalis has an unfavorable influence, and being a powerful remedy, it ought always to be administered with great caution, seldom, or not at all, in aortic regurgitation where the tendency is at any rate to sudden death. In the acute attacks of palpitation and dyspnoea, which come on especially at night, benefit may be derived from ammonia, from five drops of spirits of camphor and one of chloroform in an emulsion of gum arabic, or from tincture of digitalis and nuxvomica in ten drop doses. Occasionally a Dover's powder is very useful, but opium and chloral should be avoided as long as possible. For the



dropsy which comes on in the latter part of the malady, purgation with jalap and cream of tartar, or with elaterium, and diuretics, such as juniper berries and cream of tartar, may be resorted to with advantage, and in bad cases it may be necessary to let out the accumulated fluid in the dropsical limbs by needle punctures, as already suggested in the article on general dropsy, from which immense quantities of fluid will sometimes drain away, affording great, though unfortunately, as a rule, but temporary relief to the distressed patient. The second great indication, that of improving the condition of blood, is to be met by the administration of quinine, iron, and strychnia, as recommended in the article on *anæmia* upon page 410.

Myocarditis is an inflammation of the muscular substance of the heart, which sometimes runs on to suppuration and the formation of an abscess. it is usually secondary to inflammation of the lining or covering membranes of the organ, and is, fortunately, very rare.

### HYPERTROPHY OF THE HEART.

By this term is indicated an increase of the thickness of the walls of the heart, due to augmentation of the muscle elements. It almost invariably results from some such obstruction to the circulation of the blood as occurs in the valvular affections above described. Cases in which it appeared to arise from long continued palpitation without organic disease are, however, on record. The heart is found on careful percussion during life, or at post mortem examination, to be increased in weight and bulk, its shape being also frequently modified. The seat and extent of the hypertrophy vary according to its causes, but the left ventricle is the part usually affected. The general influence of hypertrophy of the heart upon the state of the circulation of the blood is that the arteries become fuller, the veins less full, and the circulation accelerated. If hypertrophy of the right side of the heart exists, the pulmonary arteries are gorged with blood, and palpitation, dyspnoea, pain in the chest, inability for exertion, headache, and giddiness, are common symptoms. As, however, for a time at least, the hypertrophy is only produced to compensate for some valvular imperfection, until this compensation grows excessive, there may be no general symptoms to call attention to its existence. Several different forms of hypertrophy are described, and it may be variously combined with dilatation of the organ.

Atrophy of the heart, as its name indicates, is a wasting of the cardiac substance, so that the organ becomes reduced in size. The waste occurs in the muscular structure, and the cavities retain their original capacity or may be dilated. Atrophy of the heart occurs during privation or wasting disease, and, perhaps, as a result of over accumulation of fat around the organ.

Fatty deposit around the heart is quite common in people who become very corpulent; and in animals fattened for market the heart is often found over-loaded with fat. The primary effect of this formation is to interfere, perhaps in great measure mechanically, with the freedom of the cardiac movements, and so cause difficulty of breathing on even slight exertion. Ultimately it deranges the nutrition of the heart, and leads to various forms of degeneration.

Fatty degeneration of the heart is a change of the structure of the organ, in which the healthy and natural muscular elements are partly replaced by rows of oil globules, which have, of course, no power of contraction, and can do nothing towards performing the duty of propelling the blood over its round of the circulation. Of course, if all the muscular fibres of the heart were suddenly replaced by fat globules, the cardiac contractions would at once stop, and immediate death would be the inevitable result; but a small amount of this kind of degeneration can occur, and may even increase steadily, as it usually does year after year, without proving fatal, although it does produce a vast amount of suffering, especially if the patient attempts to make the slightest additional exertion beyond the necessary movements of life. It is therefore very important for an individual affected with fatty degeneration of the heart to be as fully as possible aware of his condition, and since a portion of his heart is practically dead, being useless for performing its duty in propelling the blood during extra exertion, he must learn to live in accordance with his reduced supply of life-force in order to enjoy a comfortable existence. This knowledge can be best obtained from a careful study of the case, with all the important aid derivable from auscultation and percussion. Fatty degeneration is promoted by indolence and luxury, or by living in an impure or vitiated atmosphere, and especially by the poisonous influence of an abuse of alcohol. The tendency to its development seems to be sometimes transmitted by inheritance.

Fibroid degeneration is another form of deterioration of structure, which may likewise attack the cardiac muscle. Its progress is apt to be slower than that of fatty degeneration, and it generally depends upon some constitutional taint in the system.

Aneurism of the heart is the protrusion of the endocardium, through a spot in the muscular structure, generally weakened by fatty degeneration. It is a rare affection, but some of few genuine cases of dying from a broken heart have probably been due to the rupture of such an aneurismal sac, perhaps, during great excitement or exertion, when otherwise almost ready to give way, under the usual pressure of the blood.

Disease of the coronary arteries, preventing them from carrying the small supply of blood necessary for the due nourishing of the heart-substance, is one of the causes of degeneration of the cardiac muscle, and may terminate in sudden death. Its existence during life can, at the

most, be only suspected, and no known remedies could be of any avail in warding off a fatal result.

### ANGINA PECTORIS OR BREAST PANG.

This name is given to a nervous affection of the heart which is characterized by paroxysmal attacks of neuralgic pain in the chest, presenting almost every degree of severity. It is rarely met with in persons under the age of forty-five years, and is most frequent in men of a gouty habit. According to some authorities it is itself a part of a morbid process and not a separate disease. It is supposed to be the direct result of some indirect cause which brings on a spasmodic contraction of the minute arteries, generally throughout the system, and so throws suddenly an unusual burden upon the heart in its work. In many cases it is associated with organic disease of the heart, especially of the aortic valve. In other instances fatty degeneration of the cardiac muscle or calcification of the coronary arteries is discovered, and in a few the heart appears to be sound.

The symptoms vary from sharp transient pain to the most awful paroxysms of agony. In a typical case the suffering comes on suddenly in the chest and radiates into the arms, especially the left one. The face and body quickly become pale and covered with sweat. The countenance is expressive of the most intense anxiety and dread of impending death. The breathing is shallow, frequent, and distressing, but not really obstructed. The pulse is usually small and thready. At the height of an attack fainting or general convulsions may come on. The paroxysm is usually brief, though it may continue from a few seconds to many hours. Sometimes there is only one attack in the same illness, but generally it recurs at longer or shorter intervals, each paroxysm becoming, perhaps, more severe than its predecessor. Sooner or later angina pectoris, in its well-marked form, is apt to prove fatal.

*Treatment.*—The best treatment is the inhalation of one or two drops of the nitrite of amyl, which in favorable cases almost instantly relaxes the spasm, and affords prompt relief. Small doses of nitro-glycerine, and hypodermic injections of from one-eighth to one-half a grain of morphia, also partly relieve the pain after a little longer delay. Hot applications to the chest, and the administration of ammonia, camphor, or spirits of chloroform in five or ten drop doses, and Hoffman's anodyne in quantities of a tea-spoonful every half hour, are also recommended. During the intervals treatment similar to that advised in valvular disease of the heart ought to be carried out.



### FAINTING FIT OR SYNCOPE.

This is a failure of the heart, leading to coldness, pallor, insensibility, and loss of voluntary muscular power, commonly called a swoon. It may occur from nervous shock, bodily exhaustion, loss of blood, or mental emotion. It is to be distinguished from an epileptic or apoplectic fit by the pallor, and apparent failure of the pulse and respiration, as well as by the previous history, if that can be obtained from friends or bystanders. Generally, recovery from a swoon is rapid, if the patient is laid flat upon the ground, without any pillow, the clothing loosened from the neck, and a little cool or cold water sprinkled in the face. Care should be taken to prevent bystanders from crowding closely around a person who has fainted, and so obstructing the access of fresh air; and if hartshorn is put to the nose, it should not be sufficiently strong—as sympathizing friends in their zeal often apply it—to choke the invalid or set up inflammation of the nostrils by its caustic effect. If recovery is delayed, a turpentine injection, or one containing a little whisky and water, should be administered, and the galvanic or electro-magnetic current may be transmitted through the walls of the chest, to stimulate the failing powers of the lungs and heart.

### DISEASES OF THE ARTERIES.

The larger blood-vessels, both arteries and veins, are liable, like the heart itself, to various structural changes in disease, which, of course, lead to more or less serious disturbances in the circulation of the blood.

Arteritis or inflammation of the substance of the blood-vessel, commonly commencing with the inner coat of the artery, and extending through the whole structure of the wall of the tube, is a rare affection, and scarcely ever detected before death.

Fatty and calcareous degenerations of the arteries are much more common, and consist in the deposit of fatty or chalky material in the arterial walls, generally in patches varying in size from a mere speck to an inch or more in diameter. The fatty change is called atheroma, and the chalky is sometimes incorrectly denominated ossification. In both cases, the evil effect is, that the vessels at the involved portion lose their elasticity and their contractile power, and are easily ruptured if any extra pressure is made upon them either from the heart or from back-pressure of obstructed circulation in the veins. The rupture of minute arteries, thus weakened by atheroma, in the brain, is a common cause of apoplexy, and the bursting of large arteries near the heart, which have been similarly diseased, is often the cause of sudden death from violent internal hemorrhage.

These degenerations are not usually met with until after middle life, and no efficient medical treatment for them has yet been devised.

**OBSTRUCTION OR OCCLUSION OF ARTERIES—EMBOLISM.**

One of the most remarkable and interesting discoveries in pathology of recent years, is in regard to the separation of fibrin from the blood in the living body, in such a way as to block up one or more arteries, and so give rise to dangerous or fatal disease. The occlusion or closure of an artery may occur in two ways. In the first place, a blood-vessel may be prevented from fulfilling its office by external pressure compressing its sides so closely together that little or no fluid can flow through it. This may happen when an artery is pressed upon by some external substance, such as a tumor or growth of any kind, or by a natural organ of the body which has become displaced, or by the accumulation of fluid in a closed cavity, or from the presence in the body near an artery of some foreign substance, like an encysted bullet, for example, which presses upon the blood-vessel. Secondly, and more commonly, the artery may be obstructed by a portion of coagulated or clotted fibrin from the blood itself, which in certain diseased conditions may separate, especially about the roughened valves of the heart in chronic valvular disease; or, this coagulation of the blood may take place in the spot where the occlusion occurs, probably in consequence of disease of the artery at that point. In this latter case, the obstructing clot is called a thrombus, and the process has received the name of thrombosis. When a fragment of coagulated fibrin is formed in one part of the body, as, for example, on the roughened valves of the heart, and is carried by the swiftly rushing current of the circulating fluid to another portion of the system, as, for instance, the brain, where it becomes wedged in a cerebral artery; this moving particle of clot is called an embolus, and the disease has received the name of embolism. In some instances the particle of clot which does so much mischief, may be from an inflamed vein, as will be explained in the article on phlebitis. Occasionally, the material which occludes an artery may be something else beside coagulated fibrin from the blood. Portions of warty excrescences from diseased valves of the heart, drops of oil from various degenerated tissues, and masses of fatty substances have been met with, acting the part of an embolus; and it is highly probable that conglomerations of the minute spores, which are known to be connected with various eruptive fevers, as explained when speaking on page 281 of the germ-theory of disease, occasionally, or perhaps frequently, form plugs in the blood-vessels, and give rise to more serious symptoms than is at present generally admitted.

*Treatment.*—The treatment of thrombosis and embolism is as yet a mystery to physicians, except so far as they can palliate the symptoms which arise, and endeavor, as rapidly as possible, to improve the condition of the blood. The administration of carbonate of ammonia, in five-grain doses every two hours, is, however, recommended on the supposition that



it has the power of diminishing the coagulability of the blood. The management of the paralysis, which is a symptom of embolism of a cerebral artery, has already been referred to on page 431.

### ANEURISM OR BLOODY TUMOR.

An aneurism is a dilatation of an artery, differing from simple distension, in that the enlargement is not simply along the course of the vessel, but on one side and attended with thinning of the affected spot. It is generally the effect of a partial rupture, but such rupture seldom penetrates all the coats at once; for, though the delicate inner lining or serous coat and the muscular coat may be torn, the tough, elastic, external coat seldom gives way at first, or until after it has been distended, perhaps enormously so, for weeks, months, or even for years. This disease generally occurs as a consequence of atheroma, or fatty degeneration of the arterial walls, which become weakened and finally give way to the strong outward pressure of the blood. Aneurism is comparatively rare in the young, and is more common in men than in women, being particularly apt to appear in workmen who are obliged to make very great and sudden exertion in their trades. Persons who have inherited or acquired a syphilitic taint seem to be especially liable to become the subjects of aneurism. The most common seat of this dangerous and painful disease is in the great aorta and the vessels springing directly from it; but it is also found quite frequently in the popliteal artery, in the hollow of the knee, and less often in other situations. Among the most important varieties are the dissecting aneurism, in which there is a partial tear of one or two of the inner coats of the artery, and then the blood is forced along beneath the outer coat, dissecting it up for perhaps a considerable distance. Traumatic aneurism is that form in which the starting-point of the disease is some wound or injury to the artery; and thirdly, we meet with the diffused aneurism, in which the coats of the artery are all ruptured, but death by hemorrhage has been for the time averted by the firmness of surrounding tissues, which dilate and form the sac of the aneurism. The diagnosis of aneurism is to be made partly by the regular pulsation which can usually be felt in the tumor, if it be accessible, and partly by the peculiar "whirr" which is usually very audible. In some cases, however, the distinction can only be made with great difficulty, and after long and careful study of all the circumstances of the case.

*Treatment.*—The treatment of aneurisms inside the thorax, or the cavity of the abdomen is very unsatisfactory, and the patient generally goes on from bad to worse, suffering in most instances agonizing pain, until the sac bursts during some slight exertion, or merely from gradual thinning of its walls, and sudden death grants him a happy release. For the purpose of relieving pain hot fomentations or lead and opium lotions may



be used, and chloral and opium, or morphia hypodermically, as already suggested, should be resorted to. Digitalis, aconite, and veratrum, in from three to five drop doses of the tinctures, are recommended for the purpose of rendering the pulse and action of the heart slower so as to give the blood an opportunity to coagulate in the sac, and so by becoming organized close up the rupture, perhaps obviating any further trouble. Such a spontaneous cure does take place in a small minority of the cases, but the chance is very slender. In order to increase it, Mr. Tufnel, an English surgeon, treats cases of aneurism by confining the patients strictly to a horizontal position in bed for from eight to thirteen weeks, and keeping them throughout that time upon a restricted diet of only ten ounces of solid and eight ounces of liquid food daily, unless urgent symptoms of starvation set in. Highly favorable results have, it is claimed, been obtained by this method. Various surgical proceedings have been devised for the cure of aneurism, where it can be reached, and the success of some of the more difficult of these operations are counted among the greatest triumphs of modern surgery. As a general rule the artery is tied, if it can be got at, between the heart and the tumor, the ligature being tightened sufficiently to stop the pulsation without cutting through the vessel, lest a new element of danger should thereby be brought into the case.

### INFLAMMATION OF THE VEINS OR PHLEBITIS.

This disease leads to changes in the structures of the blood-vessel, and also to coagulation of the blood in the inflamed part, often with the dangerous sequel of embolism, as already explained on page 485. Veins are, as a rule, slow to inflame, unless the general health is very much deteriorated. When phlebitis does occur, the inflammatory changes begin in the connective tissue of the outer coat, and the pus commonly forms outside of the tube. The two varieties of this malady are the adhesive, in which the sides of the vein grow together and the blood-vessel is obliterated, and the suppurative, which goes on to the formation of pus. Its chief importance is on account of the grave danger which exists of the production of a thrombus, and of consequent embolism, as already described.

Varicose veins if neglected are liable to be at any time the seat of phlebitis, although this occurrence is not very common. This condition is more frequently met with in the calf of the leg and around the ankle than in any other part of the body. The veins are enlarged and knotted, and the skin may be so much thinned over some of these projections of the vein that it seems as if the slightest force would rupture it. This disease is brought on by standing too much without taking proper exercise, and hence printers and compositors are especially liable to it. It is also caused by any disease which obstructs the return flow of the blood

to or through the heart, such as is produced in certain liver complaints and affections of the cardiac valves. The tendency is sometimes hereditary.

*Treatment.*—The treatment of varicose veins of the leg consists in wearing an artificial support for the skin, which has failed to do its duty, either in the form of a bandage, or a laced or elastic stocking, which, when properly adjusted, affords wonderful relief. It is also a complete safeguard against the somewhat rare accident of the sudden bursting of a vein, and the consequent alarming hemorrhage. Should such an event occur, the loss of blood will almost immediately be very great, and unless efficient help is close at hand will continue until fainting is produced, at the end of a few minutes, when under the temporary failure of cardiac action clotting of the blood in the ruptured vessels usually takes place, and the bleeding is, for the time at least, stopped. The treatment of an accident of this kind is immediate pressure upon the femoral artery, at the point indicated in the figure in the chapter on accidents and emergencies, and as quickly as possible firm bandaging of the limb, especially over the seat of bleeding, where a soft rag or piece of sponge rolled in burnt alum or Monsel salt may be applied.

Vascular nævus or blood-wart is an overgrowth of the smaller veins or venules beneath patches of skin of various sizes, which, if very excessive, forms a dark purple, vascular tumor slightly raised above the surrounding surface. It may even throb or pulsate with the heart's movements. A large, diffused nævus not raised above the skin and having more of a reddish than a purplish tint is popularly called a mother's mark or port-wine stain. It can sometimes be cured by operation, but only at the risk of a scar, which will perhaps be a still greater deformity.

## DISEASES OF THE LYMPHATIC VESSELS AND GLANDS.

The lymphatic vessels may be the seats of inflammation and subsequent suppuration, and in examples of poisoned wounds of various kinds this inflammation may extend through the vessels from the point where the poison was introduced up to the nearest glands. To this diseased condition the term inflammation of the absorbents is commonly applied, and it would seem as if certain poisons, as, for example, that of erysipelas, had a special affinity for these vessels. The lymphatics are further subject to disturbance in their functions by obstruction from pressure upon them, as from a tumor lying in their course, or from disease and obstruction of glands, with which they are connected. During such obstruction the lymphatics occasionally burst, and the lymph contained in them is exuded out into the surrounding structures. Lymphatic fistula is another form of disease of these vessels, in which a lymphatic duct or tube become connected by a fistulous opening with some part outside of it, through which



it may pass. Lymphatic vessels and glands are closely associated with all the vital organs, such as the lungs, the heart, the liver, the spleen, and especially the alimentary canal. In all these parts they are, of course, subject to the various diseased modifications above described.

The lymphatic glands are particularly prone to irritation, which often runs on to inflammation and suppuration, or the discharge of pus. Many people can scarcely take even a severe cold without having the lymphatic glands of the neck, commonly called the "kernels," swell up and become painful, although, unless there is some marked scrofulous taint, suppuration rarely occurs under these circumstances. After infection with any venereal disease, the glands in the neighborhood are extremely apt to inflame, and in some forms to go on to very painful suppuration. In this way the suppurating sore in the groin, called bubo, is produced. In the true or Indian plague, accompanied with plague bubo, the lymphatic glands of the groins and arm-pits are especially liable to be affected with enormous swellings, and, if the patient survive long enough, with suppuration. The lymphatic glands are frequently involved in malignant disease, and become themselves the seat of cancer. In cancer of the breast the glands of the arm-pit are often infected, sometimes before, and very frequently after, the operation for removing the diseased mammary gland. In fact, from the way in which the malady spreads to the nearest glands in some cases, it would seem as though living cancer cells were carried from the parent tumor along the lymphatics to the nearest glands, and there, being filtered out of the lymph in which they floated, constituted the starting-points of new secondary growths of the horrible disease. The lymphatic glands are subject further to hypertrophy, the condition of enlargement being especially met with in scrofulous persons, and constituting, in fact, one of the valuable indications of the scrofulous diathesis. This enlargement may appear in an acute form, where the swelling, although rapidly developed, remains only a few weeks, and then subsides, and a chronic form in which a tumefaction which perhaps arose quite rapidly, remains for months, or a gradual enlargement may steadily go on until the gland attains a great size, is extremely firm and dense, and although showing no tendency to suppurate, is exceedingly difficult to resolve or disperse by medical treatment. Less commonly, the lymphatic glands are subject to atrophy or wasting. This generally occurs in persons who have been greatly emaciated by one of the exhausting diseases, or the atrophy may be local in its character and due to external pressure, or depravation of the proper nervous stimulus, or to the prolonged use of iodine, and so forth. The mesenteric glands, which are found in great abundance in the mesentery, or fold of membrane supporting the small intestine, are particularly apt to be seats of disease of an especially disastrous character, on account of its primary interference with the nutrition of the body. These glands receive lymphatic vessels



from the structure of the intestines, and also the lacteals which arise out of the villi, and have their name from the fluid which they contain, derived from the digested food, being of a milky color (see fig. 24). Lying, as they do, so to speak, midway between the digested food and the blood, it is in them that the alteration of the nutriment which consists in its transformation into chyle is perfected. Hence disease in them is so very serious, because it interferes with the great vital process by which food is changed into blood. These mesenteric glands are subject to the same diseases as the glands elsewhere, that is, to inflammation, abscess, hypertrophy, cancer, and tubercular deposit.

Mesenteric disease, or *tabes mesenterica*, is a wasting and painful malady, in which the glands of the mesentery become the seat of tubercular or scrofulous enlargement. It is usually developed in children who are the victims of the scrofulous diathesis, and is attended with fever, loss of appetite, pain in the abdomen, and enlargement of the veins over its surface, great disturbance of the bowels, and rapid wasting. It is often, but not always, fatal, if proper remedies can be employed in time. The most important part of the treatment, in addition to that already recommended in scrofula, is scrupulous care of the food, which should be as unirritating, and at the same time as nutritious, as possible. Very satisfactory results have been obtained in this complaint from scraped raw beef, which is sometimes digested and causes less increase of the diarrhoea than nitrogenous food in any other form.

### DISEASES OF THE DUCTLESS GLANDS.

The glands without any outlet in the body are three in number, namely, the thyroid gland, situated in the front of the neck, the spleen, located in the left side below the heart, and the supra-renal capsules, which are placed one over each kidney, deep in the loins, on either side of the spinal column. Although the exact functions of these organs are, strange to say, after all these centuries of physiological study, still undetermined, many of their diseases are well known.

#### GOITRE.

The most common affection of the thyroid gland is a chronic enlargement, so prevalent in certain Swiss valleys that the name by which it is there known is generally applied to it. In England it is called also "full throat" and "Derbyshire neck," from its prevalence in the county of Derby. Among the Hindoos it is also not unfrequently met with, and in them the tumors occasionally attain an immense size, weighing, it is said, in some instances thirty or forty pounds. At first the tumor of goitre is quite soft, but it gradually acquires a hard, or even a cartilaginous con-

sistence. In the soft condition, a viscid, gelatinous matter is found disseminated through the growth; but at a later stage this fluid appears to be collected in separate bags or cysts, and a large increase in the amount of the cellular structure of the gland, constituting a true hypertrophy, is the result. Finally, bony, or at least calcareous, that is, chalky, deposits, occur in the tumor, and the whole organ may be converted into an almost stony capsule, filled with matter of various kinds, which has been likened in different cases to jelly, honey, or suct. Sometimes the gland preserves its original lobulated form, the relative proportions being retained; at others, the whole mass is smooth and regularly rounded. The right lobe is often more enlarged than the left.

*Treatment.*—The treatment of goitre is very successful, provided it is commenced early enough, and removal from the unfavorable circumstances from which it usually originates is secured. The patient should leave an elevated and hilly country, above all the Alpine Valleys, where the absence of sunlight appears to be a great cause of the malady, and reside, if possible, near the seashore. The great internal remedy is iodine, usually given in solution with iodide of potassium, in the form of ten or twenty drops of the compound iodine solution thrice daily, and externally applied to the swelling in the form of tincture or of the ointment of iodine. In some parts of India the ointment of the biniodide of mercury has been found very efficacious. Goitre appears in some instances to be hereditary, in conjunction with the mental deficiency called cretinism, as already mentioned.

Exophthalmic goitre, or Grave's disease, is considered by some physicians a nervous affection, and is apt to be associated with anæmia and heart complaints. It comes on usually with palpitation and great frequency of the pulse, and after a time the eyeballs grow prominent, and a swelling of the thyroid gland occurs. Sometimes a peculiar thrill can be felt in the enlarged gland. The facial expression in this disease is very characteristic, and the protruding eyes and swollen face often give the countenance a peculiar frog-like aspect, which is easily recognized. The treatment consists of iron, quinine, and strychnia, as directed in the article on anæmia, with nutritious food, and morphia or belladonna to secure refreshing sleep. Digitalis as a heart-tonic, and for the purpose of controlling the exhausting palpitation, has been highly recommended in ten drop doses of the tincture every four hours. The complaint, when properly managed, does not often prove fatal, but is generally very prolonged in its duration, and complete recovery is not common.

### DISEASES OF THE SPLEEN.

Splenitis or inflammation of the spleen is rare in this country, although congestion and severe irritation of the organ during the cold stage of inter-

mittent fever are very common. The frequent repetition of the slight sub-acute inflammation occurring under these circumstances gives rise to the chronic hardening of the spleen known as ague-cake, and which has already been spoken of under the head of ague.

Leucocythæmia or white-cell blood is a disease of the circulating fluid often associated with enlargement of the spleen, and supposed to be caused in part by the morbid condition of that organ. The great characteristic of this malady, as its name indicates, is the preponderance of white corpuscles in the blood, these little bodies instead of retaining their natural proportion of one white to about three hundred of the red, assuming the ratio of one white to five or ten red ones, or even in the advanced stage becoming more numerous than the red corpuscles. As might be expected, the color of the blood when drawn is obviously paler than natural. The spleen is always more or less enlarged from an overgrowth of its pulp, and it sometimes forms an immense tumor, ten or twelve inches in length, on the left side of the body. In a large proportion of the cases some of the lymphatic glands, especially the mesenteric glands, are likewise enlarged, and occasionally multitudes of lymphoid growths, as they are called, appear in the liver, kidneys, lungs, and elsewhere. The general or constitutional symptoms are a slowly progressive anæmia, weakness and emaciation, with incapacity for exertion, shortness of breath, and digestive derangements. The bodily temperature is often somewhat raised, and sometimes persistently elevated. The urine may be normal in appearance, but less urea appears to be excreted in it. In the later stages there is a tendency to dropsy and to hemorrhage from various surfaces, especially the mucous membranes. The only certain mode of determining the presence of this remarkable disease is by a microscopic examination of the blood, and the author of these pages has devised a simple method by which any one can prepare a sample of blood for such an investigation, which can be made by an expert at a subsequent time. All that is necessary is to draw a drop of blood from the patient's finger by pricking it with a needle, and then touching this drop to a clean strip of window glass, an inch wide and three inches long, spread it out with the end of another similar strip, held at an acute angle with the first one, so that the blood may dry in an extremely thin film. If care is taken to keep such a specimen dry, and preserve it from becoming rubbed by wrapping it in soft paper, it may be retained in good condition for microscopical examination for many years, and bear transportation for thousands of miles without injury.

No specific for leucocythæmia has yet been discovered, and the little which can be done in treatment is only by way of palliating the symptoms. Nevertheless diagnosis is very important, because otherwise many cases of curable anæmia might be neglected during the time when medicine could be of the most service.



HODGKIN'S DISEASE is an unusual form of anæmia, in which peculiar white deposits are found in the spleen and some other organs, and there is great enlargement of the lymphatic glands. It generally proves fatal.

### ADDISON'S DISEASE.

This rare and curious malady, called also bronzed skin, from the peculiar tint assumed by the integument, is caused by a morbid change of the supra-renal capsules. The symptoms are the brownish olive-green hue of the skin, profound anæmia, great prostration, and remarkable feebleness of the heart's action. It generally progresses steadily and proves fatal, in spite of tonics and other general treatment, in from a year and a half to five years.

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## CHAPTER X.

### DISEASES OF THE RESPIRATORY ORGANS.

THE usual symptoms of pulmonary disease, cough and difficulty of breathing, are so constant and so unmistakable that they constitute very safe general guides to the existence of derangement of the respiratory apparatus. For the diagnosis of one disease of the lungs from another, however, it is often necessary, as already remarked, to call in the assistance of those invaluable aids, auscultation and percussion.

The operation of coughing is a purely reflex act, the result of some irritation usually about the glottis, or in the larynx and trachea. It is therefore beyond the control of the will, and though it is possible to suppress a cough to some extent, yet it is only when the reflex impulse is not very strong that even great resolution can prevent it from having its usual effect. Cough is called simple when it occurs once or twice only without intermission. Paroxysmal when it comes on in groups of efforts as we observe in whooping-cough. As to quality it may be hacking, hoarse, barking, metallic, and so on. Moreover, it may be dry, that is, without any mucus or other material being brought up, or it may be accompanied with expectoration. The different characters of the expectorated material or sputum, as it is technically called, are of no little importance in the recognition of the diseases of the lungs. The sputum typical of pneu-

monia is viscid, semi-transparent, and tenacious, adhering strongly to the vessel containing it, so much so that it may even be turned upside down without spilling. It also has a peculiar rusty color, quite different from the sputum of bronchitis, which is sometimes streaked with bright red blood, whilst that of consumption may be mingled with dark purple clots of the vital fluid. If the attack of pneumonia is not very severe the sputum may not attain the viscosity and depth of color described, moving if the vessel is tilted from one part to another, and not adhering so firmly to the sides. Should the disease progress to a favorable termination, the sputum commonly becomes more abundant, less adhesive, and less highly colored, passing through the various shades of orange, until at length it becomes greenish or whitish, and resembles that of an ordinary catarrh. If, on the other hand, the malady advances to a fatal termination, the sputum grows scanty, less firmly adhesive, and of a darker, dull-brownish hue, like the juice of prunes in tint. The sputum of gangrene or mortification of the lung is at first like a mixture of pus and mucus, perhaps tinged with blood. It soon begins to emit a very disagreeable odor, and after a free communication is established between the air-passages and the sloughing tissue of the lung, it not only acquires an intensely fetid smell, but also assumes an appearance more or less characteristic of the disease. Under these circumstances it loses its mucopurulent character, becomes quite liquid, and of a dirty greenish or ash-grey color. About the same time the breath acquires a horribly putrid odor, the pulse becomes feeble and rapid, and gives evidence of great and increasing prostration. The typical sputum of acute bronchitis appears after a few days as a thin, saltish, frothy mucus, sometimes streaked with bright red blood. This mucus increases in quantity, becomes glairy, like the white of an egg, semi-transparent, and of a faintly yellowish color. Subsequently it may assume a greyish or greenish yellow tint, and a viscid consistence. If the attack is severe the sputum may become mucopurulent, and may even lose its glairy aspect, appearing thoroughly opaque. In chronic bronchitis the sputum is not so distinctive, and may vary in its appearance from complete transparency to dense semi-solid opacity. The sputum typical of plastic bronchitis contains with the ordinary expectoration of bronchitis fragments of white fibrinous matter, or white fibrinous casts of the bronchial tubes. Lastly, the sputum of consumption resembles in many cases that of acute and chronic bronchitis, which diseases may constitute, indeed, in part the pathological conditions present, but differs from any of the other forms of expectoration described.

The acute inflammatory diseases of the organs of respiration are more or less distinctly defined, according to the tissue which they implicate, and the disturbances to which they give rise. The three structures which mainly take part in the constitution of the lung-substance, are, first, the bronchial tubes, terminating in, secondly, the pulmonary air-cells, making

up the vesicular structure, or proper substance of the lung; and third, the membrane covering this portion and forming part of that serous sac, the pleura, interposed between the lungs and the walls of the thorax. The portion of this serous bag which immediately invests the lungs is known by the name of the pulmonary pleura, whilst that which is applied over, and firmly adheres to, the inner surface of the wall of the thorax, is known as the costal pleura. One or more of these pulmonary structures may be the seat of inflammation and its results. Thus, the bronchial mucous membrane may be inflamed, in which case the disease is called bronchitis; or the substance of the lung may be inflamed, the malady being then termed pneumonia; or, lastly, the pleura may be inflamed, the condition being then designated as pleuritis or pleurisy. Rarely, however, in practice do we find these morbid states completely isolated. For example, pneumonia or inflammation of the vesicular substance of the lung, is very apt to be associated with more or less inflammation of the air-tubes, or bronchitis, on the one hand, constituting the complaint denominated broncho-pneumonia; or, it may be, there coexists inflammation of the pleura on the other hand, constituting pleuro-pneumonia. Each of these elementary morbid phenomena can frequently be distinguished by its definite symptoms; and by observing the combination of the physical signs, their association with the general symptoms, and the sequence of their occurrence, we may often determine just how far any given pneumonic disease involves one or more of the different structures which compose the lung-substance.

### ASTHMA.

This disease may be defined as dyspnoea coming on in paroxysms. The paroxysm may be preceded for a variable time by a sense of oppression and constriction about the chest, with wheezing respiration. In many instances, however, it develops without any warning, and most commonly at night. The patient awakes suddenly, scarcely able to breathe, and is forced to assume the sitting posture, or even to stand erect, with the shoulders raised and fixed, the head thrown back, the mouth open, and all the extraordinary muscles of respiration brought into play to assist those powers of the system which are usually sufficient for the purpose. The face, in severe cases, wears an aspect of terror, the eyes are widely opened, the skin is pale and dusky, and often bedewed with sweat. The feet and hands are cold, and the pulse small and quick. The breathing, however, is not hurried, but inspiration is short and jerky, and expiration inordinately prolonged. On percussion, the resonance of the chest is found to be increased, and auscultation shows the vesicular breath-sounds are weak or suppressed, and attended with whistling or cooing noises called râles. Towards the end of an attack, which may last for



several weeks, cough comes on with the expectoration of small, firm, solid pellets of mucus, in rare cases mixed with blood. The duration varies greatly, the paroxysm passing off in a few minutes or lasting for many days. When it continues long, or is left to itself, it is apt to subside gradually; but if brief, or cut short by treatment, it often ends abruptly.

The true nature of asthma appears to be that it is essentially a spasmodic contraction of the bronchial muscular fibres, causing a narrowing of the small tubes through which the air ought freely to enter the vesicular portion of the lungs. This contraction is the result of a reflex irritation, transmitted from one of the important centres in the brain which rules over this function. It is necessary to assume a condition of this centre (called the vagus centre), which renders it peculiarly susceptible to irritation, and such an irritable state appears to be in many instances hereditary. The exciting cause may be some impurity of the blood, which acts directly upon the susceptible nervous centre. More commonly, however, it is a reflex phenomenon, originating in indigestion, bronchitis, or valvular disease of the heart. The operation of other known exciting causes may be similarly explained; thus, for example, in hay asthma, the inhalation of particles, such as pollen-grains, or odoriferous emanations from hay, flowers, and from certain animals, as dogs and cats, seems to be the cause of the reflex action.

The diagnosis rests upon the paroxysmal and usually sudden nature of the onset, the absence of moist râles as determined by auscultation, and the complete recovery of patients in the intervals of their attacks. The cooing and whistling sounds heard all over the chest show the absence of any serious obstruction in the larynx and trachea, and the muscular effort being made for the purpose of inflating the lung chiefly in asthma, from heart disease, instead of also in expiration as in the spasmodic form, which we are now considering, is another indication of value.

*Treatment.*—The treatment of asthma is sometimes very successful, but no one remedy affords uniformly good results even in the same patient. Among the most certain are the inhalation of chloroform or ether, and the hypodermic injection of an eighth or a quarter of a grain of morphia, either of which, in a majority of instances, may be depended on to relax the spasm and afford prompt relief. Some of the most reliable internal remedies are chloral in fifteen grain doses, which should be employed with great caution, or not at all if the heart is organically affected, ten or fifteen drops of tincture of lobelia or of ipecacuanha, as a nauseant or emetic, belladonna, valerian, and strong black coffee. The inhalation of the vapor of stramonium leaves, produced either by burning them on a red-hot shovel or smoking them in a pipe, and of the smoke of soft bibulous paper which has been soaked in strong salt-petre water and then dried, often affords relief, and, perhaps, as often fails in its desired object.

The treatment during the interval between the paroxysms must be

directed towards building up the general health, and fortifying the nervous system against the exciting causes of the disease. In some instances the action of small doses of lobelia is highly beneficial, and in others, patients who have been for years great sufferers from asthma enjoy a complete immunity from the malady as long as they keep themselves under the influence of iodide of potassium, by taking from five to ten grains of it three times daily. If no serious disturbance of the digestive organs is produced, a continuance of several months with the remedy may be advised. The disadvantage of an eruption of little pimples or pustules upon the skin, sometimes brought out by perseverance with the iodide, is insignificant compared with benefit of relief from asthma. In some instances attacks of this disease seem by some idiosyncrasy to depend upon certain unusual exciting causes, such, for example, as inhaling the powder of ipecacuanha, or the odor of feathers, and this peculiarity when discovered should, of course, be sedulously respected. If medicinal treatment for the prevention of asthma prove unsuccessful, a change of climate, and particularly a sea voyage should be undertaken, and it is claimed by some physicians in Colorado that the air of that region is almost a specific against asthmatic complaints.

Hay asthma or rose cold is a very prevalent form of the disease, which comes on with symptoms of ordinary but severe cold in the head, constant sneezing, great discharge from the nose, and in many cases intense difficulty of breathing. Many sufferers from this curious malady are perfectly well until a certain day in one of the months of June, July, or August of every year, when they wake up in the morning, perhaps, with the symptoms above described. As already remarked, this form seems to be due to the inhalation of pollen from certain grasses or flowers, but when once commenced it may continue for several days, or even weeks, after its supposed cause has been removed. The inhalation of sulphate of quinine in powder has been highly recommended in this affection, but the air (and other attractions) of various watering places seems to be the most popular and satisfactory remedy. The White Mountains or certain seaside resorts are looked upon by some patients as absolutely necessary for their health and comfort during an attack of this complaint.

Under the title of industrial asthma have been grouped several kinds of pulmonary disease, incident to different trades and occupations. These include saw-grinders asthma, miner's asthma, Potter's asthma, and miller's asthma, caused by the mechanical irritation of minute particles of dust in the respired air, as already pointed out on pages 127 to 130.

### NASAL CATARRH OR CORYZA.

This disease, so well known to every one as a common "cold in the head," is often epidemic, and is characterized at first by chilliness with



sneezing, and later by an abundant discharge of fluid from the nose. When severe it is attended with slight fever, pain and sense of weight in the head, pain in the limbs, prostration of strength, irritability of temper, and inactivity of mind. Its origin can generally be traced to some imprudent violation of the laws of hygiene pointed out in the chapter upon heat and cold as causes of disease on page 241.

The number and diversity of the infallible remedies for a common cold is sufficient evidence of their generally unsatisfactory nature, but as the natural duration of the disease is from three to five days, the third or fourth medicine which receives twenty-four hours' trial often gains the credit of accomplishing a cure. If, as is usually the case, the bowels are constipated, a saline purgative, such as a Seidlitz powder or a bottle of citrate of magnesia, will usually relieve the headache, and then light diet, abstinence from fluids for a day, and ten grains of Dover's powder at bedtime, often seem to hasten the departure of this unwelcome guest.

### LARYNGITIS OR INFLAMMATION OF THE LARYNX.

This disease, which is one of the accompaniments of a common cold whenever hoarseness of the voice comes on, presents itself under three forms: First, the acute or œdematous; second, the subacute or catarrhal, and third, chronic laryngitis. The first of these varieties may, if not properly treated, prove quickly fatal, by closing up the avenue of entrance for the air to the lungs, and thus causing death by suffocation.

Acute or œdematous, that is to say dropsical, laryngitis may commence as a slight catarrh, quickly followed by high fever. Speech, cough, and respiration, are all soon modified. The voice at first metallic, soon becomes whispering. The cough primarily clear and shrill, then harsh and croupy is also reduced to little more than a whisper, and a peculiar noise like a loud whisper accompanies both inspiration and expiration, which are, from the beginning almost, laborious and wheezing. As soon as the œdema or dropsical swelling comes on, and still farther narrows the opening of the glottis, the effort to breathe becomes exceedingly painful and difficult, and the patient's countenance expresses great anxiety.

The diagnosis of this œdematous condition is made by the fact that the obstruction occurs chiefly in inspiration, the expulsion of air from the lungs being accomplished with comparative ease, also by the laryngoscope or by touching with the finger.

Acute laryngitis is rare in adults, and relatively common among children, but when it does occur in a grown person it is very dangerous to life. In children especially a considerable amount of spasm of the glottis is associated with the actual swelling of the edges of the aperture, markedly aggravating its effects in obstructing the respiratory process.

*Treatment.*—Since acute laryngitis in the adult may destroy life in a few



days, or even hours, it should be treated actively from the first onset by bleeding, if the patient is robust, or by leeching, active purgation with five or ten grain doses of calomel and jalap, and calomel in grain doses every two hours to the extent of producing slight salivation as rapidly as possible. If the inflammatory swelling proceed, or if oedema comes on and interferes with the respiration sufficiently to cause lividity or blueness of the lips, the operation of tracheotomy should be at once performed. It is better to open the trachea or wind-pipe sooner than is absolutely necessary, than to postpone the operation until the blood has been rendered very impure by want of a proper supply of oxygen; yet even up to the last gasp and for, perhaps, a minute afterwards life may be saved by the surgical operation. As it may be occasionally necessary when no physician can be procured, the method of procedure will be described in the chapter on accidents and emergencies.

For children the danger to life from this malady is comparatively slight, so that bleeding and calomel may generally be dispensed with, and emetics, such as syrup of ipecacuanha or Coxe's hive syrup, in ten drop doses every three hours for a child of three years old, with the inhalation of warm opiate vapors, as, for example, that from the spout of a tea-pot, in which has been placed with a small quantity of boiling water fifteen or twenty drops of laudanum are generally sufficient. The operation of tracheotomy is seldom required.

The subacute form of laryngitis rarely passes into the acute variety, and is, therefore, of but little importance. If severe, the same treatment by expectorants, nauseants, and anodynes, recommended in acute laryngitis of children may be employed. Complete rest of the voice should be enjoined, and inhalations of the various anodyne and astringent sprays, are of great service in chronic cases.

Chronic laryngitis is accompanied with actual thickening of the vocal cords, which, if the deposit be not subsequently absorbed, produces a permanent change in the voice. The respiration is usually but little affected, yet there may be a little tickling cough, an expectoration of small fragments of mucus, and an almost constant desire to clear the throat. Rest, by the avoidance of speaking above a whisper, a warm, moist atmosphere, and medicated inhalations, are the important elements of treatment in this affection in its simple form.

In certain cases of laryngitis, that curious trap-door called the epiglottis, which is provided to shut down over the glottis during the process of swallowing food, becomes inflamed, and even ulcerated. This is particularly liable to be the case in syphilitic and tubercular disease of the larynx, and must obviously give rise to very serious interference with both the operations of swallowing and of breathing. The best way to recognize the occurrence of this form of the disease, is by what is called laryngoscopic examination, and the illustration on the following page shows how,

by means of a small, metallic looking-glass, a view (of course, inverted) of the epiglottis, the glottis itself, and, in favorable instances, the interior of the larynx, with some of the upper rings of the trachea, may be obtained. This is one of the recent triumphs of mechanical surgery, and gives most important aid in almost all the diseases of the epiglottis, glottis, and many

FIG. 39.

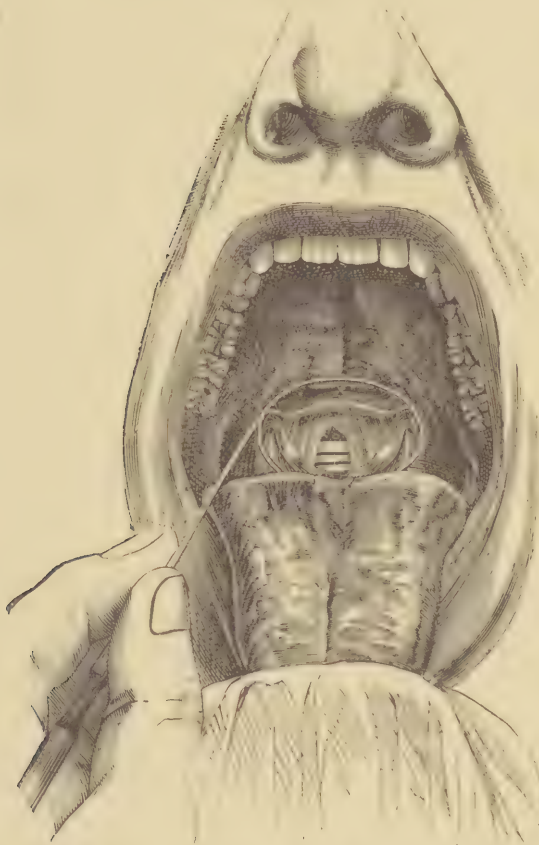


IMAGE OF VOCAL APPARATUS AS SEEN IN THE LARYNGOSCOPIC MIRROR HELD FAR BACK IN THE MOUTH.

of the laryngeal difficulties.

When, by means of the laryngoscope, the existence and seat of an ulcer can be established, it should be touched with a strong solution of nitrate of silver, in the hope of thereby promoting a tendency to heal; or inhalations of astringent solutions, such as that of the sulphate of zinc, or of copper, and of carbolic acid, may be employed. In syphilitic ulceration, there is often danger of a gradual contraction of the chink of the glottis, leading to great difficulty of breathing, and even suffocation, if not relieved by tracheotomy. In such patients, the active constitutional treatment to be recommended in a future chapter becomes very important, and should be pursued with the utmost perseverance. Moderate

counter-irritation over the front of the throat, by means of small blisters, tincture of iodine, and pustulation with croton-oil, is often very beneficial. Chronic laryngitis may occur in either the secondary or the tertiary stages of syphilis, but it is in the latter period that we meet with the deep, destructive, and obstinate ulcers of the epiglottis. In the secondary stage the syphilitic warts and superficial ulcerations may appear upon the epiglottis, but are more apt to develop on the vocal cords which form the edge of the glottis. The laryngoscopic examination is particularly valuable in the diagnosis of tubercular deposit in the larynx, because such a complication of pulmonary consumption is

so common that the change of the voice, which depends on it, is an important indication of the existence of that fatal malady. At first, only slight redness and swelling may be observable, but soon the edges of the vocal cords begin to thicken, and appear in the laryngoscopic mirror as two pale, pear-shaped tumors, the large ends meeting posteriorly in the middle line, and the epiglottis is also seen to be thickened. Subsequently ulceration of the vocal cords comes on, and occasionally necrosis or mortification of the little arytenoid cartilages follows.

*Treatment.*—Treatment by astringent applications, and external counter-irritation sometimes affords temporary relief, but the prospect of recovery from consumption, thus complicated, with disease of the glottis, is nearly hopeless.

### TRUE CROUP OR PSEUDO-MEMBRANOUS CROUP.

This dangerous and much dreaded disease is unfortunately very common among children, and seems to depend in some cases upon hereditary tendency. It is rare after childhood, affects boys more frequently than girls, and is not contagious. It is not common before the second year of life is completed, and after the seventh year the danger from it rapidly diminishes on account of the development and widening of the larynx, which occurs about that period. It differs from the ordinary form of laryngitis in the disposition which exists to the formation of an exudation or false membrane upon the glottis and interior surface of the larynx which, if it cannot be coughed up, is very apt to produce death by suffocation unless tracheotomy rescues the patient. This membrane may vary from a mere film to a dense coat of a quarter of an inch in thickness. It is believed by some eminent authorities to be identical with the diphtheritic membrane, but in the opinion of the present writer these two diseases are totally different, although diphtheritic croup frequently manifests itself, and is exceedingly fatal. (See article on diphtheria, page 363.)

Croup often begins gradually, with the signs of an ordinary cold, a harsh cough, harshness of the voice or cry, sore throat, and slight fever, preceding the more violent symptoms for a day or two. The actual attack is apt to make its appearance at night, the child being awakened, from a restless sleep, perhaps, with a croupy or barking cough partly suppressed, a hoarse or whispering voice, and severe oppression of breathing. The dyspnoea chiefly affects the inspiratory effort, which is long-drawn, high-pitched and whistling in its character. The sides of the nostrils are in active motion, and the child tosses about, clutching at its throat, as if trying to tear away some obstacle situated there, which prevents it from getting its breath. A little viscid mucus may be expelled by coughing, which, however, affords scarcely any relief. The skin is hot, the temperature often rising three or four degrees in a few hours. The pulse is fre-



quent, hard, and full, and the face is flushed or dusky. In most cases, these alarming symptoms abate towards morning, the fever subsiding, the cough growing less frequent and distressing, the voice returns although it is still hoarse, and the respiration, though noisy and wheezing, is no longer painful. All the symptoms, however, usually recur the next evening, in favorable cases with slightly lessened intensity, but in the majority with greater severity; and this is apt to go on, if not interrupted by treatment until a fatal result ensues. Death from strangulation in true croup is one of the most painful as well as distressing among our many paths to dissolution.

The diagnosis of this malady from spasmodic or false croup has already been pointed out, as has also that from diphtheria, with which it is often confounded. From simple catarrhal laryngitis the distinction is often difficult, but shreds of false membrane expelled by coughing, and membranous patches upon the pharynx, point to croup, and in this latter disease the dyspnoea is more urgent and the fever more intense.

*Treatment.*—Since it must be expected that true croup will prove fatal in a majority of cases, in from three to five days, active treatment should be commenced as early as possible. The child should be at once placed in a warm bath, and, if very robust, a few leeches may be applied to the throat with advantage. After removal from the bath, by which the spasmodic element in the difficulty of breathing will probably be more or less relieved, the child should be quickly rubbed dry, put to bed in flannel, and made to breathe an atmosphere saturated with moisture by keeping a large kettle of water boiling in the room continually. The vapor of slaking lime, associated with steam by slaking a lump of quicklime at short intervals of ten or fifteen minutes in the room, is believed to aid in loosening the false membrane. If the breathing is much impeded, some rapidly-acting emetic, such as half a tea-spoonful of powdered alum, or the turpeth mineral in two-grain doses, given cautiously in a little honey and water to a child of five years every ten minutes until it operates, and then repeated every six or eight hours, according to the strength of the child and the urgency of the symptoms, has often proved highly useful. The tincture of aconite in half-drop doses every fifteen minutes, until its effect in reducing the pulse is evident, and then every hour or two, so as to keep up its influence upon the circulation, is highly praised, but must be cautiously employed. Antimonial wine, wine of ipecacuanha, or Coxe's hive syrup, in doses of from ten to twenty drops every hour, are often of great service. Should feebleness of the pulse indicate approaching exhaustion of the vital powers, alcoholic stimulants must be resorted to, but the tendency to prostration is seldom so intense as that which appears almost from the beginning in diphtheritic disease.

There is no doubt that the operation of tracheotomy has saved many lives which would otherwise have been destroyed by croup, and it should

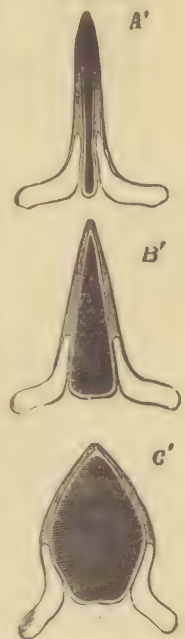
therefore be performed as soon as it seems probable that medicinal treatment will not avail. According to German statistics, out of nearly seven-hundred cases of tracheotomy, a fraction over one-fourth recovered; and there is little doubt that in many of these instances, had the operation been resorted to earlier in the attack, a larger proportion might have been rescued. Professor Flint advocates the operation also, because even if life is not saved by it, relief from dyspnoea is procured, and the mode of dying by asthenia or debility is substituted for that one which involves most suffering, namely, slow suffocation. The performance of the operation, continues Dr. Flint, is a duty whenever symptoms render it probable that the treatment otherwise will prove unsuccessful, without raising a question as to the percentage of successful cases. It is often opposed by the parents or relatives of children suffering from this affection. The duty of the physician is then to state fairly and fully the grounds on which his opinion of its importance rests, thus relieving himself of responsibility for its non-performance.

### DISEASES OF THE VOCAL CORDS.

The development of new growths or little tumors within the cavity of the larynx is a cause of local obstruction to the breathing, which is happily rare. The three different kinds which have been met with are, first, the warty growths, having a firm structure, and attached to the inner surface of the laryngeal cavity by a broad base; second, polypoid growths, similar to those already mentioned as occurring in the nose, of a soft and jelly-like consistence, attached to the mucous membrane by a pedicle or stem; and, third, cysts or hollow bags, containing, in some instances, parasites.

Paralysis of the vocal cords, resulting in aphonia or loss of the voice, is a very grave misfortune under certain circumstances, as, for example, to clergymen or lawyers. The vocal cords, which are not strings, as might be imagined from their name, consist of the thin edges of folds of membrane and elastic tissue which stretch across the top of the larynx from before backwards, and by their vibration produce the voice. The changes in position which these vocal cords undergo in the different processes in which they are concerned, will probably be understood by reference to the accompanying diagram. At *A* is shown the appearance of the chink of the glottis, formed by the edges of the vocal cords, as it appears when examined by the laryngoscope whilst the patient is engaged in singing. *B* exhibits the condition in which it usually appears during easy and quiet respiration;

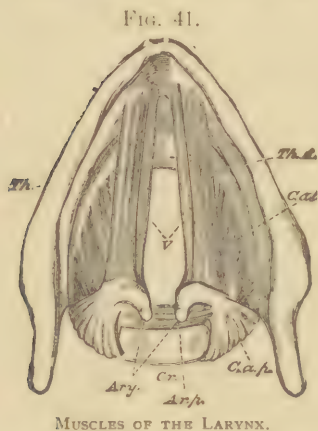
FIG. 40.

CHANGES OF POSITION  
OF THE VOCAL CORDS.



and at *C* is represented the arrangement during forced inspiration or drawing a long breath. These changes are brought about in the relative positions of the vocal cords, by delicate little muscles, and it is the effort to keep the edges of the chink of the glottis pressed firmly together, and the vocal cords which form these edges tightly stretched, so as to give out a shrill note in their vibration, that proves so exhausting, to some singers very quickly, and to all after a prolonged continuance of the exertion. A strain of the voice may in fact consist of the actual rupture of some of the fibres of these little muscles, which, if they unite at all, sometimes require weeks or months for the accomplishment of the operation.

The figure in the margin illustrates the arrangement of the muscles of the larynx, as seen after the membrane and elastic tissue constituting the vocal cords has been removed. *Th* represents the large and firm thyroid cartilage; *Ary* the upper ends of the arytenoid cartilages, to which the



posterior ends of the vocal cords are attached; *V* indicates the position of the vocal cords; At *Arp* is represented the band of muscle called the posterior arytenoid muscle, which has the duty of pulling the arytenoid cartilages together, and so narrowing the slit of the glottis between the vocal cords as to cause the production of just the right sound for any particular note in singing. The mechanism of hoarseness in the voice or cough is simply as may be understood with ease from this diagram, that the edges of the vocal cords becoming thickened by congestion or slight inflammatory action can no longer vibrate

quickly enough to produce the higher notes of the voice. The great danger of oedema or dropsy of the glottis consists in the rapid swelling of the connective tissue beneath the cords to such an extent that the sides of the glottis meet in the middle, and, of course, cut off all access of air to the lungs, unless tracheotomy is performed, and an entrance thus furnished for the air to come in below the point of obstruction to revive the dying patient.

The hygiene of the voice, that most important tool of their trade to clergymen, lawyers, teachers, actors, and singers, is in its fullest sense the hygiene of the whole animal economy, so that the spirit of the well known proverb, which sets forth how closely is interwoven the integrity of mind and of body, might with equal propriety be applied to the voice in the form of *vox sana in corpore sano*. As the voice, however, has, like the mind, a sphere of its own in which it may be affected without immediately influencing the rest of the organism, we may properly consider its special as well as its general hygiene.



In the professional use of the voice the anatomical tissues concerned are incited to perform their functions to a much higher degree than is ever exacted in the ordinary circumstances of social life, and these parts are therefore apt to undergo marked structural changes.

Vocal expression is the result of two consecutive and specially combined movements, the one primary and vital, namely, activity of muscle; the other secondary and physical, to wit, motion of air.

The systematic daily use of the various groups of muscles called into action during speaking or phonation, impels them to gain in size and strength as long as the effort made does not exceed their limit of power or endurance. By its greater ease in performing the respiratory functions, extension of mobility of the larynx and articulating apparatus, and improved nutrition of the local muscles and of all the contiguous structures, are secured.

But *over exertion* sets in operation a precisely opposite series of phenomena. Under its baleful influence the muscles involved become exhausted and diminish in bulk and vigor, because the waste of their tissues entailed by excessive action is pushed beyond the reparative powers of the vital forces, and fresh material cannot be laid down in an equal quantity to that which passes away as effete.

Over exertion may be of two kinds, first, sudden and violent effort, or second, prolongation of ordinary movements until endurance is completely spent. In the former case the harm partakes more of the nature of traumatic injury, some of the muscular fibres and minute blood-vessels, or capillaries, being torn across. Hence arise the soreness or pain, swelling, and even extended inflammation similar to that commonly occurring from a strain or sprain. Convalescence from such a condition is often protracted. In powerful vocal efforts all the muscles engaged may suffer in this way, and be rendered sore to the touch, and during respiration; but the muscles most likely to be strained are those of the larynx, because they are called on to contract very forcibly, in order that the vocal cords may resist by their steady approximation, the impetuous rush of air from the lungs. Such an occurrence, sometimes spoken of as a strain of the vocal cords, is betrayed by hoarseness, which, however, generally disappears spontaneously after a few days of rest, although weakness of voice is often a troublesome symptom for a considerable time.

More persistent, but less violent, vocal exercise also gives rise to consequences somewhat similar to those just described. If not frequently repeated such injuries are soon remedied by natural reparative processes, but habitual exertion of the vocal organs beyond the enduring power of the individual brings about a radical exhaustion of the respiratory muscles; the voice loses its fullness and steadiness, becomes weak and trembling, and finally worn out.

According to the very old, but very true, Latin aphorism which asserts

that wherever there is an irritation in the body thither there will be a flow of blood, it is, of course, quite impossible to exercise the vocal organs continuously for any great length of time without producing a certain amount of laryngeal and pharyngeal congestion. If the blood and all the tissues are in a perfectly healthy condition, this congestion may entirely subside without any permanent structural change of the parts involved, but too generally it happens that a chronic or sub-acute inflammation of the mucous membrane is produced, with its unfortunate mechanical results, hoarseness and, ultimately, extinction of the voice.

Much of this evil effect can, however, be obviated by attention to a very simple hygienic precaution, namely, that of inhaling the necessary air whilst speaking chiefly through the nose instead of through the mouth. This is particularly important when speaking or singing in the open air, especially if that air be cold or damp, because the impact of such cold or moist air upon the throat, larynx, and above all the vocal cords, whilst congested during the effort of phonation, is most disastrous in its effects. By attending to this rule of inhaling through the nose, the air is somewhat warmed, perhaps also purified, during its passage over the nasal fossa, and so important does the celebrated British lecturer, Prof. Tyndall, consider this precaution that he is reported as saying that the one great verbal legacy which he wishes to leave to the English people is, "Keep your mouth shut."

In paralysis of the muscles of the glottis, which, small as they are, the explanation given a few pages back shows to be very important, not only is the power to produce audible voice sounds lost, but breathing is rendered difficult, and great distress is produced by the inability to take a long breath. Aphonia is of two kinds, the simulated and the true. An imitation of the real disease is generally hysterical in its character, and though it may last for a long time, is never really permanent; it may sometimes be recognized by the aid of the laryngoscope. True aphonia is due to actual palsy of these little laryngeal muscles, is generally dependent upon some serious injury or disease, and therefore in most instances incurable. The treatment of the pretended aphonia is that of hysteria, for a description of which see page 443.

### COMMON COUGH OR BRONCHIAL CATARRH.

This every-day disease is a sub-acute inflammation affecting the larynx, trachea, and larger bronchial tubes, sometimes commencing with nasal catarrh and travelling down, as it were, to the pulmonary organs. At other times, or in other patients, it appears to originate in the larynx, and does not affect the nasal passages at any time during its course. The predisposing causes to this common affection are enumerated as being the loose flabby texture of tissue in certain individuals, especially those who



are the subjects of the scrofulous diathesis, and rickety children, second, a previous attack, and third, effeminate modes of life. The directly exciting causes are, first, chilling of a portion of the skin, and especially the change of temperature of a portion of the body produced by sitting in a draught of air whilst perspiring freely, or with damp clothing or wet shoes; second, irritants acting directly on the mucous membrane lining the air-passages, such as dust, acrid vapors, or hot and cold air, and the irritating materials given off in certain trades, such as those of saw-grinders, millers, and stone-cutters; third, obstruction to the current of the blood through the great branches of the aorta below the origin of the bronchial arteries, such as may be caused by abdominal dropsy, accumulation of gas, or of refuse matter in the intestines; and fourth, as a result of morbid states of the blood, as seen when bronchial catarrh is a premonitory symptom of typhoid fever, measles, and small-pox. In some parts of the United States a catarrh is understood to mean only a chronic cold in the head, which is attended with a profuse discharge of mucus, and is very difficult to cure. This, however, is not the true signification of the word catarrh, which is in reality a name for inflammation of any mucous membrane. Thus, for example, we may correctly speak of catarrh of the bladder, or catarrh of the bowels.

The general symptoms of a common cold on the breast are so well known to every one that it is not worth while to occupy space in describing them; and yet, frequent as is popular acquaintance with this disease, few persons realize the terrible dangers which attend upon a neglected cough. With the insidious predisposition to consumption, which lurks furtively or parades itself openly in perhaps half the families of America, awaiting the advent of some exciting cause to give it a chance to spring into action, it is often a matter of life and death to the large majority at some period of their lives to promptly cure an ordinary cough and cold.

*Treatment.*—The most important thing in relation to this malady is to *prevent its occurrence*, as has been pointed out in the chapter on cold. This could probably be accomplished in four cases out of five by the exercise of a troublesome amount of prudence, which, however, would be well expended were young people willing to make the effort to escape this frequent cause of early death. When, however, a person is unfortunate enough to contract a cough by his own imprudence or otherwise, it may often be cut short by bringing on a free perspiration. A good way to accomplish this is to take a hot mustard foot-bath and ten grains of Dover's powder on retiring for the night, wrapping the throat up in flannel if it feels sore, and being very careful not to undo, and more than undo, the beneficial work of this treatment by uncovering oneself in the night, or by imprudent exposure the next day. If this method is not resorted to early enough, or if it fails and the cough goes on unchecked, ten drop doses four times a day of antimonial, or ipecacuanha wine, and nitrate of



potash, or muriate of ammonia in quantities of five grains every three or four hours, are generally useful. By the third or fourth day great advantage may be derived from the use of a mixture of half a tea-spoonful each of syrup of squills and syrup of wild cherry with one-twelfth of a grain of acetate of morphia and the same quantity of cyanide of potassium every six hours. If this remedy agrees with the patient it may be taken more frequently or in sufficient doses to quiet the cough through the night, but it must be used with great caution, as it contains ingredients which are poisonous in over-doses. Should the disease persist notwithstanding the employment of these various medicines, counter-irritation with croton-oil and tincture of iodine applied to small spots on the upper part of the chest in front, or croton-oil alone rubbed on the back, also with great caution, should be resorted to without that further delay during which the catarrhal irritation of the bronchial tubes might become chronic, as it is commonly phrased, and the cough get such a hold that it cannot be shaken off. A very important part of the treatment is the breathing of a continuously warm, moist atmosphere, and for children especially, the prescription of one warm room is probably more conducive to recovery than any one of the medicines suggested. Particularly ought young children, in whom previous experience has shown there exists any tendency to croup, to be guarded against the development of that dangerous affection by even the slight additional exposure of passing through a cool entry to their meals. At the same time the apartment to which the invalid is confined must not be kept too warm, and due attention should be paid to its proper ventilation, as already directed.

### BRONCHITIS.

This disease, an inflammation of the bronchial tubes, or air-passages leading to the pulmonary vesicles, is characterized by hoarseness and moderate cough, with heat and soreness of the chest in front, all these being more or less intense according to the severity of the attack. In every common cough there is always some bronchitis, but the element of danger lies in the extension of the inflammatory action to the smaller bronchial tubes or bronchioles, and the approximation consequently to that fatal form of the malady termed capillary bronchitis.

Simple bronchitis is usually ushered in with a slight chilliness, general discomfort, and some febrile disturbance. A sense of constriction about the chest and some deep-seated soreness beneath the breast bone soon follow. The respiration is slightly increased in frequency, but no urgent dyspnoea is generally present, unless the patient is a sufferer from some chronic affection of the heart or lungs, as, for example, valvular disease of the former organ. Cough is uniformly present in bronchitis, is worse after sleep, and, as a rule, paroxysmal. The expectoration is at first

scanty and viscid, but soon becomes more abundant, white, and frothy, and still later yellowish or muco-purulent. In this latter stage the cough is looser, less painful, and the phlegm is expectorated more easily.

Capillary bronchitis usually develops out of the simple form, and therefore its onset can hardly be said to be characterized by any well-marked symptoms. Occasionally, however, a sharp chill defines the date of its attack. When developed the patient breathes with difficulty, the complexion is dusky, and the countenance betrays anxiety. The superficial veins are over-filled, as a consequence of the obstruction to the pulmonary circulation, and the movements of the sides of the nostrils are exaggerated. The respiration and pulse are quickened, the former very much so, and out of proportion to the latter. The cough is almost constant, and the expectoration at first frothy, and after a time yellowish, is expelled with considerable difficulty. Troublesome pains in the intercostal muscles, brought on by the unremitting exertion of coughing, are of frequent occurrence, the temperature rises to a considerable elevation, and the restlessness is extreme; the renal excretion is scanty, and sometimes a little albuminous. In fatal cases the prostration becomes intense, the skin livid, cold, and clammy. Dropsy of the feet and legs may come on, and at last fitful drowsiness or muttering delirium precede coma and death. The duration of this dangerous form of bronchitis varies from one to three weeks, and relapse, though it does occur, is less common than recurrence. The signs on auscultation and percussion are highly significant. There is no increase of dullness on percussion, indicating solidification of the lung, but the sounds of the breathing are coarse and noisy, and accompanied by snoring or whistling rales, which can often be heard by the patient or even by persons standing at some distance from him.

The diagnosis of acute bronchitis is ordinarily not difficult. Capillary bronchitis must be distinguished from pneumonia, which can generally be done by the greater amount of fever and disturbance of the respiration as well as the dullness on percussion, tubular breathing, and irregular distribution over the chest of the latter affection. In acute tuberculosis, or galloping consumption, the violence and irregularity of the fever, the rapid collapse of strength, and the extreme dyspnoea, out of all proportion to the physical signs, indicate the nature of the case in most instances.

The prospect of recovery in early childhood, in advanced old age, and in patients who are suffering from previous disease of the lungs and heart, is more or less unfavorable, and the capillary form in young children is especially fatal. With these exceptions, recovery from acute bronchitis may generally be anticipated.

*Treatment.*—A threatened attack of bronchitis may sometimes apparently be cut short by a hot foot-bath and dose of Dover's powder, as already suggested, and a full dose of ten grains of salicin or of quinine

will perhaps aid the good work of this treatment. After the disease is fully developed the remedies are chiefly palliative, and consist of opiates, such as morphia and atropia, or preferably, in many cases codeia, in half-grain doses, to quiet the cough and promote the expectoration. The softening of the secretion, and easing of the incessant cough, are also promoted by keeping the patient in a moist atmosphere, as suggested in regard to croup. Pain in the chest can often be relieved by mustard-plasters and stimulating liniments, or painting with tincture of iodine. Half tea-spoonful doses of the syrups of squills, ipecacuanha, and lobelia, every two, three, or four hours, according to the urgency of the symptoms, are probably useful, and the iodide of potassium, in five-grain doses, if well borne by the patient without irritating the mucous membranes of the eyes and throat, as it sometimes does in a singular way, is highly recommended. There is no need of restricting the diet in this disease, and any wholesome food which the patient craves may be allowed. In the treatment of the capillary bronchitis of young children it is necessary to use opiates with much greater caution, and the occasional administration of an emetic, to aid in clearing out the accumulated mucus, is important. Counter-irritation by mustard or turpentine may be tried, and dry cupping often gives great relief.

Chronic bronchitis is a very common malady, its frequency increasing with the coming on of old age. It may be chronic from the outset, or be the result of the acute form. Chronic lung diseases generally are apt to lead to it, and so does the abuse of alcohol.

The winter cough of old people, which improves as the spring advances, and is often lost entirely during the hot weather of summer, but only to reappear in the following autumn, is usually a chronic bronchitis. With each succeeding year during the period of decay of the human frame, it is apt to come on a little earlier, and last a little later, until, finally, a winter arrives in which the patient succumbs to his persevering enemy; or, it may be, he falls a victim to an attack of acute bronchitis, superadded by some accidental cold to the chronic variety. Through all these years, which may number a score or more, it is astonishing what large amounts of muco-pus, reaching sometimes the quantity of half a pint every twenty-four hours, can be expectorated without much apparent injury to the general health. Dry catarrh is a name applied to chronic bronchitis without much expectoration, sometimes met with in gouty persons, and often relieved by iodide of potassium and colchicum, as already directed on page 383.

Bronchial dilatation is liable to come on in the course of obstinate bronchitis, and when once markedly developed, usually prevents any complete cure of the bronchial affection being accomplished. It can only be recognized and distinguished from the lung cavities of consumption, with certainty, by the aid of auscultation and percussion, and its



chief importance is from a diagnostic and prognostic point of view, as the treatment does not vary much from that appropriate in chronic bronchitis.

### PNEUMONIA OR INFLAMMATION OF THE LUNGS.

This disease, called also lung fever, is the most serious of the common acute diseases of the pulmonary organs. Long continued exposure to cold is apt to be the exciting cause of pneumonia; but there are some reasons for supposing that it is, at least in many instances, a local manifestation of a general disease, perhaps contagious in its character. It often comes on in the course of other grave maladies, and adds very much to their fatality. The three stages through which this complaint passes in typical cases, are, first, that of congestion, where the lung is engorged with blood; second, that of red-hepatization, in which the inflamed lung is dark-red and solid like a piece of liver, sinking in water and breaking down readily under the pressure of the finger; and, third, the stage of grey-hepatization, in which the affected pulmonary tissue is still dense, but of a yellowish-grey color. The terminations of this stage are, first, the more common and favorable liquefaction of this exudation and removal by absorption or expectoration; second, cheesy degeneration and the development of consumption; third, gangrene or mortification; and fourth, the formation of an abscess. The lower lobe of one lung is generally affected, but it may involve the whole of one side and part of the other, or it may be confined to the upper lobe; some inflammation of the pleura, constituting pleurisy, generally accompanies pneumonia.

The symptoms of an ordinary attack of pneumonia, coming on from exposure to cold, in a robust adult, are quite characteristic. The disease usually sets in with a single severe and prolonged chill, after which the temperature of the body rapidly rises to a high point, and this rise is accompanied by the customary symptoms of fever. Pain is commonly felt about the region of the nipple on the affected side, and is sharp, stabbing, and aggravated by movement in breathing or otherwise, and also by pressure. There is, likewise, well-marked dyspnœa, characterized by extremely frequent, shallow breathing, quite different from the kind of dyspnœa observed in bronchitis and in asthma; the rapidity of respiration ranges from twice to four times the frequency of health, that is, from about thirty to sixty per minute; and this increase in the number of the respiratory efforts is partly due to fever, partly to mal-aëration of the blood, and partly to the pain which prevents drawing a full breath. The sides of the nostrils are commonly in active movement at every inspiration. The third prominent symptom is cough, generally frequent, hacking, and constrained, on account of the suffering which it causes. It is

dry at first, but on the second or third day the patient commences to bring up, at each paroxysm of cough, some of the peculiar, viscid material of exactly the color of rusty iron, which has already been mentioned when speaking of the general indications of pulmonary disease, a few pages back. This expectoration does not occur in young children, is often absent in secondary pneumonia, and in the pneumonia of the aged. The fever usually attains its height on the second or third day, when the heat of the body usually ranges from  $103^{\circ}$  to  $105^{\circ}$ , and excepting some slight daily variations, this temperature is commonly maintained until the turn of the disease, which may take place on the fifth, seventh, or ninth day. The skin feels excessively hot, dry, and burning. The pulse is frequent, running from eighty to one hundred and twenty in the minute, but the increase in the rapidity of the pulse is generally so much less than the increase of the rate of respiration, that this difference forms an important diagnostic symptom in doubtful cases.

The pulse is usually strong and full at the outset, but later on in the attack it becomes small and weak, partly as a result of the imperfect filling of the arteries from obstruction of the pulmonary circulation, and partly from cardiac feebleness. The cheeks are flushed to a very marked degree, and an eruption of little blisters, a variety of herpes, is sometimes present upon the lips, which are of a dusky hue. Prostration, feebleness, headache, restlessness, and delirium at night, are common. The tongue is dry and coated, the thirst is eager, but the appetite for food is lost and the bowels are costive. In persons who have been previously enfeebled by vicious excesses of various kinds, by other diseases, or by old age, pneumonia is apt to be of a very severe form, taking what is called a malignant typhoid, or adynamic type. This is marked by intense nervous disturbance, high delirium, convulsions, and coma. In children, the primary chill is usually replaced by an attack of convulsions or of violent vomiting. In favorable cases, these symptoms which have been detailed gradually increase up to the fifth, sixth, or seventh day, and may then rapidly subside, the temperature falling to the natural standard two or three days later, and the solidified portions of the lung clearing out occasionally with wonderful celerity. The cough and dyspnoea speedily abate, and the sputum becomes yellow and muco-purulent. When the malady ends fatally, death usually occurs about the end of the first or early in the second week, and results from failure of the action of the heart, or else from pulmonary embarrassment. Often the pulse, in elderly people at least, shows indications of the approaching cardiac failure, by becoming intermittent for two or three days before dissolution. The chief signs afforded by auscultation and percussion in typical cases of pneumonia, are so well marked that almost any one can recognize them. They depend upon the total change in the physical condition of the portion of lung which has become solid in the second stage, and an entire loss of reso-



nance on percussion, and great increase in the clearness with which the sounds of bronchial breathing, coughing, and speaking, come to the ear over the affected portion of the pulmonary organ.

*Treatment.*—In the treatment of pneumonia, the old method of bleeding freely in almost every case has become obsolete, and the probabilities are that many patients who would be benefited by the operation are now not bled because it is contrary to the medical fashion of the day. There is no doubt that the intense pain accompanying the onset of pneumonia can be promptly relieved by blood-letting; but since the tendency of the disease is towards death by debility, and it is impossible to say in any given case how far over the pulmonary structure the inflammation will extend, we can never feel sure that the loss of the vital fluid abstracted will be safely borne by the patient. In very robust persons, in the prime of life, it is proper to bleed; because the chance of diminishing the violence of the attack thereby is at least equal to the danger of seriously decreasing the strength. In less vigorous individuals, leeching or cut-cupping, and in patients of feeble constitutions, dry-cupping, will generally afford considerable relief. Large doses of quinine, even as much as twenty or twenty-five grains, may be given at the first onset, in the hope of cutting short the disease, and later on for the purpose of reducing the fever, which in itself is a great cause of danger, as already explained. Opiates in the form of Dover's powder, the hypodermic injection of morphia, or of codeia in half-grain doses, when the latter medicine suits the patient, are of great service in diminishing suffering, procuring sleep, and allaying cough. They should be used with great caution or not at all, when there is much blueness about the lips, or the difficulty of expectorating the tenacious sputum is evidently great. Towards the latter part of a severe attack the chief treatment is that of nutrition and stimulation, and as there is often in this disease a great tolerance by the nervous system of alcohol, such as we see in typhoid fever, immense amounts of milk punch, or diluted brandy and whisky, are sometimes consumed with apparent benefit. Alcoholic stimulants should never be given to the extent of producing symptoms of intoxication, but short of this point they are of great service in keeping up the action of the heart, and thus preventing the fatal effect of cardiac failure.

Since the immediate cause of death in many examples of fatal pneumonia is the over-distension of the right side of the heart, with consequent separation of fibrin in the partially stagnating blood constituting heart-clot, it is advisable to diminish this tendency to coagulation of the blood in the heart, and the production of a thrombus by the administration of five grains of carbonate of ammonia every three or four hours, which, however, ought not to be continued for more than a day or two.

During convalescence from inflammation of the lungs danger from relapse is not nearly so great as in many other maladies, such, for example,



as diphtheria, and hence free indulgence of the appetite for all wholesome food and out-door exercise, as soon as the strength permits, may be allowed.

Abscess of the lung, which has been referred to as one of the results of pneumonic consolidation, is a circumscribed accumulation of pus in the pulmonary tissue, corresponding to that which occurs in an ordinary boil. It is not often met with in open, acute pneumonia, but is the common effect of the breaking down of tubercular deposit, and occasionally follows the entrance of some foreign body into the organs.

Gangrene or mortification of the lung-structure usually takes place in the third stage of pneumonia of the worst variety, or infrequently from embolic obstruction to the circulation. It is almost always fatal when it extends over a large part even of one lung.

### EMPHYSEMA OF THE LUNG.

This is a condition in which the lung-structure is inflated with air, beyond the natural capacity of the elastic air-vesicles, during the act of inspiration. It is very similar to the forcible distension accomplished by blowing air into the lungs of an animal after being removed from the body, and deprived of the support of the chest walls. The two varieties of emphysema are, first, the *vesicular*, in which the vesicles are distended and dilated, and the *interlobular*, in which the air has escaped from the air-cells in consequence of their rupture, and diffused itself through the connective tissue of the pulmonary substance. This condition is commonly the result of accidents leading to great straining in the respiratory muscles, as in the violent paroxysms of hooping-cough, and of asthma, and men or animals who are the subjects of emphysema, are popularly and very accurately described as "broken winded." A variety of emphysema called senile emphysema is very common among aged persons. The symptoms of emphysema are in direct proportion to the amount of lung-tissue affected, and consist of dyspnoea which resembles that of asthma, and is unlike that of valvular disease of the heart in being especially marked during the effort at expiration. Cough is usually present, but is not attended with expectoration, unless the disease is complicated with chronic bronchitis, as is frequently the case. In bad cases of emphysema the interference with the aëration of the blood is so great that the complexion is dusky and the patient languid and dull. The general appearance of an emphysematous person is so characteristic that his complaint can be recognized at a glance, for the middle of the chest is so distended as to justify the name of barrel-shaped, which is commonly applied to it. The ribs in this portion are nearly horizontal, but the lower part of the thorax is often contracted. The difficulty of breathing in emphysema is often aggravated by co-existent spasm, such as occurs in asthma.

*Treatment.*—The treatment of this disease is limited to palliating the symptoms as much as possible, and remedying the maladies, such as chronic bronchitis or asthma, with which it is frequently complicated. Anodynes, which appear urgently called for to relieve the pain and distress, must be employed with caution on account of the imperfect aëration of the blood, which is already an element of danger. Dry cupping between the shoulders is often of service, and the use of quinine, iron, and strychnia, as directed in anæmia, is beneficial by improving the general health. Change of residence to a warmer and more equable climate than that of the northern United States is probably the best remedy we can urge upon patients afflicted with emphysema.

### PULMONARY PHTHISIS OR CONSUMPTION.

This most fatal of all our diseases is a condition comprising a number of different morbid states of the lungs, among which the most important are the following:

Tubercular phthisis or true pulmonary consumption is that form in which the peculiar tubercular matter is deposited in the lungs in small masses or tubercles, varying in magnitude, but generally about the size of a mustard seed. Such tubercles become centres of irritation, inflammatory action, and suppuration, or formation of abscess, and these processes end by destroying a smaller or larger spot of the lung-substance, and leave a cavity or vomica in the pulmonary structure. The disease is constitutional, apparently hereditary, and according to the researches of Dr. Koch, the celebrated Berlin microscopist, contagious, the whole malady being the result of development in the lung of a very minute bacterium, named by Dr. Koch the bacillus tuberculosis. In America it is usually developed between the time of puberty and the twenty-fifth year, and in nine cases out of ten seems to be primarily lighted up by a cold or some depression of the nervous system. Hæmoptysis or spitting of blood, usually in small quantity and only serious as a symptom of very grave import, is often one of the earliest indications of pulmonary consumption.

The importance of the subject of this article is shown by the fact that in New York, Philadelphia, and Baltimore, over fourteen per cent. of all the deaths are from consumption of the lungs, and probably one-quarter of the entire mortality is attributable to the consumptive, that is, the tubercular diseases. Indeed, Dr. Holmes has asserted that about one-half of all the adults you meet in the streets of Boston is, has been, or will be the subject of some form of tubercular disorder.

Acute phthisis or galloping consumption is the most rapid form of this terrible disease, and has been known to prove fatal in the short space of six weeks. It usually commences with chills and fever of the hectic type.

Cough, dyspnoea on very slight exertion and out of all proportion to the apparent amount of disease in the lungs, is almost a characteristic of the complaint. The expectoration soon becomes profuse, and is frequently tinged or streaked with blood. This blood is never mixed throughout the sputum so as to give it the color of rusty iron, which is so indicative of pneumonia. The pulse is frequent and feeble, the tongue red and furred, the appetite poor or absent entirely, and there is often a tendency to diarrhoea. In the rapid progress of the disease there is, after a few weeks, great exhaustion, profuse sweating, speedy emaciation, and restlessness, amounting in persons of nervous temperament to delirium. Acute phthisis coming on in this way is almost without exception fatal, but in rare cases there may be a decrease in the violence of the symptoms, and the patient enjoys a temporary improvement, only, however, to pass into the ordinary condition of chronic consumption, as next described. Cases of acute phthisis have been mistaken for typhoid fever when the febrile excitement and delirium were unusually prominent, but a careful observation of the temperature, by the aid of the thermometer morning and evening, will generally prevent error. In doubtful instances a microscopical examination of the expectoration for elastic fibres of the pulmonary air-vesicles, has been especially urged by the present writer as a most valuable means of diagnosis.

*Treatment.*—The treatment of some of the very few cases which have ever been reported as cured was that of rest in bed, a liberal supply of fluid nutritious food and stimulants, frequent application of iced-cloths to the chest to subdue the fever, these being at once removed if there was any tendency to faintness thereby produced, hypodermic injections of atropia to check the sweating, and pills or powders containing two grains of quinine, a half grain of digitalis, and opium in amounts of from a quarter to half a grain, four, five, or six times daily.

The onset of chronic pulmonary consumption is generally gradual, and marked by one or more of the symptoms of progressive debility and by loss of flesh, chronic dyspepsia, diarrhoea, alterations in the voice, and in females suppression of the monthly periods. In more than half the cases spitting of blood occurs, and a cold or cough is apparently the starting-point in very many instances. A dull, aching pain just below the collar-bones in front or the shoulder-blades behind is very often complained of, even whilst the amount of tubercular deposit is small, and is probably due to little spots of pleuritic inflammation. Muscular pains in various parts of the frame are often present. The short, dry, hacking cough of early phthisis is usually referred to some irritation about the larynx or trachea, but is, in reality, due to irritation of the bronchial mucous membrane, from the inflammatory changes induced by the tubercular deposit. It may continue for some time without being much aggravated, or without any other definite symptom making its appearance, and yet each



paroxysm may be followed by the expectoration of a little pellet of thick, yellowish sputum, in which careful microscopical examination will detect pulmonary elastic tissue, and prove that the destruction of lung-substance is actually going on. In other cases the cough is loose, hollow, and less distressing, accompanied by the expectoration of a copious frothy phlegm derived from the congested mucous membrane of the bronchial tubes. Weakness of the voice and hoarseness are very common, and a purplish mark upon the edges of the gums, where they come in contact with the teeth, is often observable, and is thought by some physicians to have considerable diagnostic value. In at least fifty per cent. of the patients spitting of blood appears early, and recurs at various intervals, giving the first positive evidence of the existence of consumption. It is much more frequent in the first than in the second or third stages, and may vary from one or two tea-spoonfuls to the same number of pints. Very rarely, however, is the expectoration of blood in the early stage of consumption directly dangerous to life. Among the other symptoms loss of strength is one of the most constant. The patient soon finds that slight exertion, such as ascending a little hill, or even a short flight of stairs, causes fatigue, hurries the breathing, and often gives rise to palpitation. The uterine functions in women are apt to be disturbed, and the liver becomes congested and tender. The tongue gets red and irritable, and little sores called *apthæ* form upon its sides, and on the mucous membrane of the fauces. The membrane lining the bronchial tubes, the larynx, and the pharynx generally, is apt also to become affected with a low form of inflammation, and emit a superabundant secretion as a consequence, whilst not infrequently tuberculous deposit occurs in the sub-mucous tissue, leading to ulceration and serious destruction of the structure. This deposit seems especially apt to occur when the fauces are relaxed, and the uvula or soft palate, as it is often called, elongated, since the constant cough and irritation thus set up prevent all attempt at healing of the painful little sores. It is remarkable how the nails become incurved and the ends of the fingers clubbed, a symptom, however, which is not characteristic of consumption, as it is noticed in other wasting maladies. As time goes on the mischief proceeds, it may be steadily, but often by irregular degrees, and with marked but delusive periods of temporary improvement. Hectic fever coming on towards evening and giving a deceptive appearance of the flush of health to the emaciated countenance develops. There is a total loss of appetite with great thirst, and, partly as a consequence of this absence of nourishment, the loss of flesh is almost visible from day to day. The hair grows thin and loses its attachment to the scalp, so that quantities come out on brushing it. The debility is extreme and night sweats make their appearance, still further exhausting the little remaining strength. Every morning on awaking the body may be found bathed in a profuse perspiration, which some-

times even wets the pillow and bed-clothing for several inches around the person. In females there is a total cessation of the menses, which is a most discouraging evidence of failure in vital power. The patient continues to lose flesh until he attains the condition popularly described as nothing but skin and bone. An unmanageable diarrhœa, due perhaps to disordered secretions of the digestive fluids, or more frequently to tubercular ulcerations in the intestines, often sets in, and conspires with the other causes of debility to utterly prostrate the unfortunate invalid. The lower limbs become very painful, and dropsical swelling of the feet and ankles appears, constituting what is vulgarly called the bloating consumption. Towards the close, cough and abundant expectoration become, if possible, even more troublesome, so that the sufferer is often unable to sleep for more than a few minutes at a time on account of the disturbance the paroxysms produce. Great nervous restlessness, cramps in the legs, pain about the loins, distress in passing water, utter prostration, and the ever present difficulty of getting the breath, tend to render the last few nights of existence most agonizing to both the patient and the attendant relatives. Death is anxiously looked forward to as the only available relief from such unspeakable misery, and at last the sleep from which there is no awakening, though sometimes strangely delayed for hours, or even days, ends the scene, the mental faculties remaining clear almost to the termination of life.

It is so important that the diagnosis of consumption should be made at the earliest possible period, when the chance of life by change of climate is greatest, and this early recognition depends so largely upon a nice discrimination of the evidence furnished by auscultation, percussion, and microscopical examination, to the trained senses of an expert, that no one else should attempt to take the responsibility of giving a positive opinion. Where such a reliable decision cannot be procured near home, a journey of the necessary length—be it a hundred or a thousand miles—to settle the question, would well repay any honest inquirer after the exact truth in regard to his condition, wherever there is reasonable ground for suspicion as to the existence of consumption. After the disease is fully developed, and the abundant expectoration, great loss of flesh and strength, night sweats, and associated sore throat from laryngeal tuberculosis manifest themselves, there is often no room for doubt that consumption has developed, even without the aid of auscultation and percussion; but in the incipient stage just grounds for suspicion are furnished by the presence of slight hacking cough which has resisted the usual remedies, such as have been pointed out in the article on bronchial catarrh, a little spitting of blood, provided the patient can be sure that it does not come from the gums or from the back part of the nose, and marked dyspeptic symptoms, with loss of flesh and strength out of proportion to the length and apparent severity of the illness. Since spitting



of blood does not occur in perhaps one out of every three cases of consumption, its absence in any particular instance is not as reassuring as its presence is alarming. The danger of a little hacking cough being the forerunner of serious pulmonary disease is very much greater if the patient is between fifteen and twenty-two years of age and comes of a family in which there is any hereditary tendency to phthisis. Hence in any individual case the suspicion is vastly heightened by the knowledge of such a family predisposition, which may be judged of with a good deal of accuracy in accordance with the suggestions made in a former chapter, on pages 46 to 50.

The duration of an attack of consumption varies within very wide limits, since it depends upon such varying elements as the primary stock of individual vitality and strength of constitution, the frequency and severity of accidental exposures and imprudences, and the consequent increase of the original disease by superadded bronchial irritation, the virulence of the hereditary tendency, the partial and temporary success of various kinds of treatment, and many other factors which cannot be appreciated by human foresight, and if foreseen, could not with our present knowledge be accurately calculated. Excluding the examples of acute phthisis on the one hand, and those cases of prolonged struggle with the malady in which it is probable that a cure of one portion of the diseased lungs may take place, even whilst the malady is advancing in other parts of the pulmonary structure, the average duration of consumption may be set down approximately at from two to five years. In many instances which ultimately prove fatal, the favorable effects of medical treatment, and especially of change of climate, are very marked. The patient gains flesh and strength, a little color returns to the cheek, the cough grows less troublesome or almost disappears, and it really seems for a time as if one of those rare triumphs of medical skill—a case of cured consumption—was to be the reward of so much persevering effort. But after a summer passed, perhaps, in these bright anticipations of permanent recovery, some slight, accidental exposure to the blasts of the next or the following winter, gives another cold, the insidious malady appears only too often to be thereby aroused to a new malignancy, and in a few sad weeks not only is all the apparent improvement swept away, but new ravages in the pulmonary organs of the sufferer manifest themselves, so that the victim speedily descends into the dark valley by the painful and toilsome pathway already described. The actual percentage of cures in true pulmonary consumption is probably not over five per cent.; that is to say, the chances are that genuine phthisis will terminate existence within four or five years, in nineteen out of every twenty cases, provided change of climate, persevered in for a long series of years, or still better, for life, is not adopted.

*Treatment.*—The treatment of consumption consists in the palliation of



symptoms and the administration of table-spoonful doses, thrice daily, of cod-liver oil, the phosphates or hypophosphites of iron, lime, and the alkalis; the internal and external use of iodine, and last but not least, of persistent counter-irritation over the diseased spot in the lung, generally near its top and just below the collar-bone, with tartar emetic ointment. Nearly all the cases of recovery from well-defined phthisis, coming under the observation of the writer, have been apparently due in large measure, to this system of treatment. In the second stage of consumption, that is, after the deposit of tubercular matter has begun to soften, and before any large cavities have formed, the prospect of cure by this or any other treatment is diminished; but even from the third stage—that of the formation of large cavities and extensive destruction of lung-tissue—recoveries occasionally occur, as in the case of the distinguished Dr. Bennett, referred to on page 49.

The palliative treatment of consumption, unfortunately the chief service which medicines can render, consists in relieving the cough and pain in the chest by expectorants and anodynes, as advised in our article on chronic bronchitis, improving the appetite and strength by tonics and stimulants, controlling the diarrhœa with astringents, and correcting the derangements of digestion with antacids and other anti-dyspeptic remedies. Most patients afflicted with phthisis will find themselves for a time benefited by, first, a cough mixture composed of acetate of morphia, cyanide of potassium, syrup of squills, and syrup of wild cherry or syrup of tolu, as already suggested, used chiefly at night to promote sleep in the nocturnal hours and allow the expectoration necessary to relieve the lungs from their accumulated load of sputum to be carried on in the daytime; second, by a pill of two grains of quinine, half a grain of digitalis, and one-fortieth of a grain of strychnia, with the addition of half a grain of iron, should the condition of anæmia exist and there is no tendency to spitting of blood to forbid its employment; third, by a mixture of a tea-spoonful of syrup of krameria, five grains of prepared chalk, twenty drops of compound spirit of lavender and ten of wine of opium, to check diarrhœa when that appears; and fourth, by powders containing five grains each of bismuth, soda, charcoal, and pepsin, or ten of lacto-peptine, with wine-glassful doses of the infusions of gentian or columbo, as may be found best adapted to the particular case as stomachics. For patients with whom morphia or opium disagrees, codeia, lactucarium, chloral, bromide of potassium, or hyoseyamus, may perhaps be substituted, and in some instances morphia, where illy borne alone, becomes quite acceptable to the stomach when associated with one one-hundredth of a grain of atropia, or with twenty grains of bromide of potassium. When obstinate diarrhœa torments the invalid, the metallic astringents, such as half a grain of sulphate of copper, or one-quarter of a grain of nitrate of silver, thrice daily, are frequently useful, and occasionally a tea-spoonful

of powdered resin succeeds in controlling the intestinal disorder when all other remedies prove unavailing. The profuse and debilitating night sweats may be often checked by sponging with finely-powdered alum and whisky, by full doses of quinine, or by hypodermic injections of the sulphate of atropia.

Seeing, however, that the prospect of curing consumption by medical treatment is so mournfully gloomy, it becomes doubly important to urge that every patient whose circumstances will admit should resort to a change of climate. And this migration ought to be made with scarcely a day's delay after some amply competent authority has determined by thorough examination the necessity of such a change in the colder seasons of the year.

The next question is, whither should a journey for this purpose of preserving life be directed? and, in a general way, it may be replied, first, that the climate selected ought to be one of equal, or nearly equal, temperature, throughout the twenty-four hours; in the second place, it should be equable, or, in other words, there should be a comparatively small range of average temperature of the successive months in any particular season; and, thirdly, the relative humidity, as indicated by the wet and dry bulb-thermometer, should undergo but little variation from day to day, or from week to week, at the same season of the year. This is the more important because a drier climate is generally found to be better suited to the earlier, and a more moist one to the advanced, stages of consumption. It is also urged by some climatologists that a residence under a high barometrical pressure is useful for both the prevention and cure of pulmonary diseases; whilst on the other hand, medical practitioners in Colorado and other places, where the pressure of the air is very much diminished by the high altitude, and the barometer stands at perhaps twenty-five inches only, claim that their rarefied atmosphere has a direct curative power.

Among the climates which are more or less honestly advocated for consumptives may be prominently mentioned:

First—The climate of Florida and the West Indies.

Second—That of Minnesota and Colorado.

Third—The climate of California; and—

Fourth—That of the south and west of Europe, including Italy, Southern France, and the Canary Islands.

The excessive heat of the early summer in Cuba, Florida, and the other Gulf States renders a residence in their climate only useful during the winter, which, as the wet season, is not without its disadvantages, for the patient suffering from incipient phthisis. The climate of Minnesota, which may be taken as a fair example of that which prevails throughout our northwestern territories, does not afford the conditions already laid down as favorable to persons with weak lungs—the mean winter tem-



perature at St. Paul's, for instance, being  $16^{\circ}$  or  $17^{\circ}$  F. below the freezing point, whilst the average summer temperature is  $68^{\circ}$ , a difference of  $53^{\circ}$ . The winter is severe, the thermometer sometimes marking a temperature of  $39^{\circ}$  below zero; but it is not equably so, the daily mean temperature varying on an average during each month  $51^{\circ}$ , and in March sometimes manifesting the excessive vicissitude of  $74^{\circ}$ . Even the daily variations frequently amount to  $20^{\circ}$ , occasionally to  $30^{\circ}$ , and rarely to  $40^{\circ}$  in the diurnal cycle.

The differences of temperature in Denver, Colorado, are even more striking. Thus, in January, 1873, the recorded maxima and minima were  $62^{\circ}$  and  $-17^{\circ}$ , a range of  $79^{\circ}$ ; in April they were  $10^{\circ}$  and  $81^{\circ}$ , a range of  $71^{\circ}$ ; and in October,  $5^{\circ}$  and  $86^{\circ}$ , a variation of  $81^{\circ}$ .

A severe commentary upon the Western climate, as a whole, is the small number of well-authenticated cures recorded. It has been estimated that of those consumptives who visit Minnesota, not more than one in fifteen recovers.

The climate of the Pacific Coast is analogous to that of Western Europe, that of Oregon resembling the climate of Norway and Great Britain, whilst the average temperature of Southern California is very similar to what we meet with in Portugal and Spain. The chief difference is due to the effect of the cold winds from the Pacific, which render the summers cooler; after they subside, however, the temperature rises, so that September is the warmest month of the year in San Francisco, and October is warmer than July. The difference here in the mean temperature of July and January is only about  $9^{\circ}$  instead of over  $45^{\circ}$ , as sometimes met with in Philadelphia. The average temperature for the winter is  $65^{\circ}$  in the southern part, near San Diego,  $59^{\circ}$  at San Francisco, and  $45^{\circ}$  in Southern Oregon. South of Monterey, especially at Santa Barbara, the climate is dry, warm, equable, and decidedly invigorative, so that it is remarkably well adapted to persons threatened with pulmonary complaints.

According to many observers Madeira and the Canary Islands possess, as far as mere climate is concerned, the greatest advantages for the continuous residence of consumptives, being the most equable of all mild climates. In Madeira the annual mean temperature is  $68^{\circ}$ , that of winter being  $63^{\circ}$ , spring  $65^{\circ}$ , summer  $71^{\circ}$ , and autumn  $70^{\circ}$ . The greatest difference between the average daily temperatures is but  $11^{\circ}$  in August and January, and the usual diurnal variations rarely exceed  $10^{\circ}$ . It is reported that at one town on the island the thermometer for forty years did not fall below  $60^{\circ}$  or rise above  $80^{\circ}$ . The climate of the Canary Islands is very similar to that of Madeira, but they do not possess quite as great advantages in the way of good society and home comforts for invalids.

The Western European and Mediterranean climates are mild and



equable, but in none of them can the winter be entirely left behind, as it may be in Madeira and the Canaries. Dr. Henry Bennett, already mentioned as a remarkable example in the medical profession of an invaluable life saved by change of climate, preferred Mentone, a small town of Northern Italy on the Gulf of Genoa, for a winter residence, living there from the middle of October to the latter part of May, and spending the rest of his time in London, which he considers the best summer climate in Europe.

But with all the benefits of change of climate many cases of consumption prove incurable, and as the advantages of travel are inaccessible to the vast majority, the wisest direction in which human effort can be expended is in avoiding all the causes of phthisis as far as known. It may be well here to remind the reader that probably in half the patients who die of phthisis it is the combination of the exciting causes with the predisposing ones which determines an onset of the fatal malady, so that at least fifty per cent. of all the deaths from consumption *are preventable* by due care and hygienic treatment in protecting the subjects of hereditary tuberculous tendency, and so securing the dormancy through life of this predisposition towards pulmonary disease.

Impure air as an exciting cause of phthisis is very prolific, and contributes largely to swell the death-roll of this disorder. This is due to the fact that, except food, oxygen from the air is the most important factor of the chemical changes which, whilst they have their starting point in the pulmonary organs, are absolutely necessary to the continued vitality of the whole organism. Life implies *change*, its activity is in proportion to *change*, and for this oxidation is requisite. If then the air is deprived of its normal proportion of oxygen, or is loaded with extraneous substances, nutrition, strength, and vigor are all profoundly affected.

Even in the open streets of cities and large towns the atmosphere, according to Prof. Wilson, contains a sensibly diminished proportion of oxygen. How much more serious then must be the scarcity of this vivifying element in our ill-ventilated rooms or halls, to say nothing of the pent-up tenements and lodgings of the poorer classes. That this is a very important consideration is indicated by the English army sanitary commission's report, published in 1858, which shows that the excessive mortality from consumption among soldiers, especially in particular regiments was due to insufficient ventilation and contracted quarters. The air in the barracks of the Foot Guards only amounted to 331 cubic feet for each soldier, the recognized standard space being 1000 cubic feet, and the mortality from phthisis was as high as 13.8 per 1000 annually. In those of the Horse Guards, on the other hand, with a space per man of 572 cubic feet, the mortality from phthisis did not exceed 7.3 per 1000. After the report was made, the number of cubic feet was increased and the ventilation improved, in consequence of which the number of phthisical

cases occurring was materially diminished. Among the poor, who in all cities are necessarily, by the effect of high rents, crowded into quarters more narrow than even these guardsmen occupied, not only are persons compelled to breathe their own breaths over and over again, but the oxygen of their rooms undergoes an additional rapid exhaustion by their gas-burners, lamps, and sheet-iron stoves. The organic matter, smoke, and carbonic acid, produced by these agencies are exceedingly injurious. Persons predisposed to consumption, or those who have a delicacy about the organs of respiration, therefore, should not, if possible, be allowed to live in large cities, where the air is so impure, but should be given outdoor occupation in the country, where even in-doors the open fire places and the penetrating winds force the impure air *out of*, and pure air *into* the house.

Dwellings in which the air is close, musty, and ill-smelling, are not only unhealthy, but positively poisonous to people with weak lungs. In such houses volatile organic matters collect in quantities and saturate the air, which, when inhaled, only partially arterializes the venous blood, and consequently the nutritive functions are so lowered that inflammatory processes leading to caseous deposit occur readily in the lungs. In this way it is easy to explain why neglect of ventilation is such a fruitful source of consumption. Persons living in such an atmosphere of *second hand* or rebreathed air which, although it does not suffocate, lowers all the organic processes of the body, may think they are not being poisoned because the poison is slow in acting; and yet all the while a progressive deterioration of the forces of life goes on, and consumption is very frequently the result.

Another common exciting cause of consumption in large cities is the deprivation of sun-light. To say nothing of the dwellings of the poor built upon narrow courts or alleys, houses of the better class are now often erected so as to have three rooms upon a floor, and in such cases the middle one, frequently occupied as a nursery, is quite cut off from the rays of the sun. Parents will place their children in situations of this kind which they would never permit their flowers to occupy, unless they wished to bleach them. Indeed, it is really true, that plants show a higher appreciation of sun-light than the better half of the highest in the scale of animals, because plants, wherever possible, will eagerly turn and twist themselves to face the light. In the eloquent words of Sir David Brewster, "Light is the very life-blood of nature, without which everything *in nature* would fade and utterly perish." Hence there is hardly any surer way to develop a predisposition to consumption, or if there should be no actual hereditary tendency, of *creating* this disease, than by depriving a system in which the pulmonary organs are delicate, or even sensitive, of a due allowance of light.

The influence of in-door, and especially of sedentary life, are very marked

as exciting causes of phthisis, because they are both violations of the laws of health, which require of necessity more or less active muscular exercise in the fresh air. Statistics show that out of a thousand deaths from consumption there were of patients from

|                                                                 |     |
|-----------------------------------------------------------------|-----|
| Occupations carried on among vegetable and mineral emanations . | 176 |
| “ “ “ “ various dusts . . . . .                                 | 145 |
| “ “ “ with a sedentary life . . . . .                           | 140 |
| “ “ “ “ workshop life . . . . .                                 | 138 |
| “ “ “ in dry and hot air . . . . .                              | 127 |
| “ “ “ “ a stooping posture . . . . .                            | 122 |
| Whilst with active muscular exercise (in the house) . . . . .   | 89  |
| Living in the open air only . . . . .                           | 73  |

Dr. B. W. Richardson found that no exciting cause of consumption is so general as in-door occupation, which gave rise in his series of 515 cases to sixty-eight per cent. or more than two-thirds of all the attacks. Among the different in-door trades which were noted at the Brompton Hospital for diseases of the chest (London) shoemaking gave the largest percentage of cases of phthisis; after the shoemakers came in the order named, needlewomen, watchmakers, domestics, painters, tailors, printers, writers, and cigarmakers. Many of these tradesmen not only breathe confined and therefore impure air whilst in stooping or sitting postures, but are compelled to inhale particles of metal, as in saw, edge-tool, and cutlery manufactories; dust and fibres of flax, cotton, and wool, in mills of various kinds; fragments of hair in brush factories, and so forth. The influence of different kinds of dust adds greatly to the effect of in-door occupation and confined air as a fruitful cause of consumption, because the angular particles inflict mechanical injuries upon the delicate lining membrane of the lungs; such injuries are followed by low-grade inflammatory exudations, which soon degenerate, and by ulceration give rise to the excavated cavities of phthisis.

Dampness of the soil in connection with a high level of the ground-water as a cause of consumption has already been alluded to, and this is probably one of the causes of the great mortality among consumptive patients in this climate during the months of March, April, and May, when the spring rains have raised the stratum of sub-soil water nearer to the surface of the earth. Among the wealthy a danger of the opposite kind, that of living in over-heated houses, where the air is *too dry* and causes irritation of the lungs by drying up the mucus and rendering it more viscid and, of course, much more difficult to expectorate, is to be guarded against. Persons with weak lungs should regulate the moisture of the air in their apartments by the aid of the wet and dry bulb-thermometer, keeping the relative humidity at about sixty or seventy per cent. of saturation.

Still another exciting cause of phthisis is imperfect nourishment.



This begins in early life, during which it is probably rare for the juvenile human being to receive proper food in sufficient quantities and frequently enough. Such is the case not only among the poor, who have the excuse of not being able to afford to do otherwise, but also among the well-to-do and the rich. Children during growth and development need in proportion to their weight more food than those who have attained their full proportions, and who only require enough to repair the effects of their waste and simply to keep up their nutrition. Dr. Erasmus Wilson published some years since a suggestive little book on the necessity of giving meat to children, after they have their first or deciduous teeth, three times a day. In meat, as we all know, the predominating nutritive principles are the nitrogenized, which form the basis of the material in which are exhibited the chief manifestation of life. Children ought to have substantial meals five times daily, eating on each occasion as much as the stomach will digest. All varieties of wholesome food should be given to growing boys and girls, because it is upon the firmness and strength of the tissues built up at this period of life that much of the subsequent health of the organism depends. This is especially the case in cities where milk and butter, which contain all the elements of nutrition in their most easily digested form, are not taken as freely as is necessary, partly from the difficulty of procuring them pure and fresh as in the country, and partly on account of the misconception as to their true value. This neglect of furnishing, especially to the young and the growing, an ample supply of that most easily digested and most nutritious of the hydro-carbons, *butter*, has probably no small influence in promoting the spread of pulmonary consumption. The large amount of butter and cream eaten by country-reared children is no doubt one great cause of the superior healthfulness and immunity from tuberculous and scrofulous affections which they enjoy.

### PLEURISY.

This disease is an inflammation of the pleura, or delicate membrane which surrounds each lung, and which can be easily torn off in a dead animal. It is thin, elastic, semi-transparent, and envelops the lung as a serous bag or sac, everywhere double, which is consequently reflected or turned back on the inner walls of the chest, covering them completely. Its two surfaces, which face each other, produce in health just enough of a watery fluid to keep them moist, and prevent any more friction than can be helped during the almost constant motion of the lungs upon the inner surface of the thorax in the process of respiration. As soon, however, as inflammation of the pleura is set up, from any cause, this beautiful provision is interfered with, and the smooth and shining surfaces of the pleura become roughened, so that instead of gliding freely over

one another, they rub together with a grating noise called, from its origin, a friction sound, which furnishes the best guide for a physician to the existence of pleurisy.

Pleurisy presents itself under two forms—the acute and the chronic. Its common cause is exposure to cold, but sometimes it arises from injury, as, for example, from the pleura being wounded by the jagged end of a broken rib; or, secondarily, adjacent inflammation, such as takes place around a nodule or tubercular deposit in consumption, or in the course of some other disease, for instance, Bright's disease or scarlet fever. The onset of acute pleurisy may be insidious, but generally, when arising from its usual cause, exposure to a very severe cold, it is rather sudden and marked by repeated chills. As soon as the patient reacts from these, the temperature begins to rise, but rarely exceeds  $102^{\circ}$ , and thus furnishes a distinguishing symptom which often enables the complaint to be discriminated from pneumonia. At the same time, or very soon after this rise in temperature, pain, cough, and dyspnœa are observed. The pain is almost always referred to the affected side, a few inches below the nipple, and is sharp and darting, described as resembling a stab with a keen knife, especially on trying to take a deep inspiration or to cough. As a rule, the dyspnœa is slight, and mainly due to the pain in the side, and to the febrile excitement in the system. In fact, when these have subsided, it is remarkable how little the breathing is disturbed, even when effusion of fluid into the cavity of the pleura in large amount has occurred, so long as the patient remains quiet. Marked or persistent dyspnœa generally indicates, therefore, that there is pneumonia in addition to the inflammation of the pleura. The cough is short, hacking, and accompanied with little or no expectoration. In order to breathe more fully with the sound lung, the patient generally lies on the affected side, though, if the chest-wall is thin, so that pressure causes increased suffering, a position upon the back may be selected by the invalid. The pulse is quickened, but only in proportion to the amount of fever present, in this respect also exhibiting a marked contrast to inflammation of the lungs. The tongue is somewhat furred, the appetite impaired, but the thirst is increased, and the bowels are confined. After a variable period, averaging, perhaps, between one and two weeks, the attack usually terminates in recovery, with or without a contraction of the wall of the chest on the affected side, according as the lung is able to expand after being compressed by the effused fluid; or the malady may end in the chronic form of pleurisy, or very rarely in the uncomplicated affection it may have a fatal result. The processes which go on inside the thorax during an attack of pleurisy, are, first, the roughening of the surface of the pleura, above referred to; second, the secretion of fluid into the cavity of the serous membrane, of course, as it progresses, compressing the lung and preventing it from taking part in the operation of breathing. This effusion may amount to



several pints, and in bad cases sometimes not only squeezes all the air out of the lung which it encloses, but pushes over the heart out of its proper place, and, by compressing the other lung, to some extent interferes with its performance of duty. In favorable cases this fluid is absorbed again after a while, and the pleural surfaces come in contact with each other once more. The exudation of lymph which has also been thrown out on the surface of the inflamed membrane, disappears more or less completely, and what remains becomes organized into fibrous tissue, causing adhesions between the two surfaces to a greater or less extent. If these adhesions become firm over a large surface of the lung, after a time they contract, and tie down, as it were, the pulmonary structure, which, being unable to expand against this force, the chest-wall sinks in to meet it, and the patient suffers a proportionate reduction of his breathing capacity, besides being the subject of the pitiable deformity sometimes seen after an ill-managed pleuritic attack. The term *empyæma* is applied to the disease when this effusion is made up of pus, or ultimately becomes converted into a purulent fluid.

In chronic pleurisy the effused liquid remains in the pleural sac, without becoming absorbed. It is especially apt to become purulent in a short period in children, or in persons whose health is impaired from any cause. When this degeneration takes place, there is always more or less febrile disturbance of a hectic type set up in the system generally. The skin of the affected side after a while becomes, over the seat of the effusion, reddened, tender, swollen, and dropsical. The finger nails are often clubbed, as in consumption, and night sweats are not infrequent. Cough is apt to be troublesome, and may be accompanied by an expectoration of mucus, which in rare cases possesses a putrid odor. Complete recovery may take place, either by absorption of the fluid, by spontaneous discharge into the bronchial tubes, or externally, or by the operation of drawing it off by aspiration and other surgical proceedings. In a smaller number of cases the cure is incomplete, owing to the persistence of morbid changes in the lung, or the establishment of a pleural fistula or running sore, communicating with the pleural cavity. Lastly, the exhausting nature of the discharge and other disturbances may wear out the strength, and death occur from debility. In some cases, where recovery takes place, with the adhesion of the surfaces of the pleura by a thick, false membrane of organized lymph, chalky deposit may occur in later life, and by the hardness of the uniting material, mechanically interfere still further with respiration. In other instances, this false membrane may undergo cheesy degeneration, and thus become the starting-point of consumption.

The diagnosis of pleurisy without the aid of auscultation and percussion, must often be difficult, at least for the first few days of the attack, but it can sometimes be made from pneumonia by the lower grade of fever, the small amount of dyspnoea, and the total absence of rusty expect-



toration. It can be distinguished from bronchitis by the small amount of cough, and the sharpness of its pain, and from acute phthisis by the strength being but slightly diminished. Without skillful auscultation, it may often be confounded with intercostal neuralgia and intercostal rheumatism, although the general absence of fever, as shown by the thermometer, in these two diseases, will frequently aid in making the distinction correctly. Fortunately, such a mistake is not likely to lead to important evil results. The friction sounds of the first stage of pleurisy are often very faint, but the dullness on percussion of the affected side, after effusion occurs, with total absence of the breath-sounds, instead of tubular breathing, such as is heard in pneumonia, can often be detected by the merest novice in the art of physical examination.

*Treatment.*—The treatment of pleurisy in the first stage, when acute pain is the most prominent symptom, is bleeding, leeching, or cupping, over the affected side, if the patient is robust and previously in good health. In persons of feeble constitution it is better to apply ten or twelve dry cups, and then use hot poultices with laudanum for the further relief of pain, than to deplete the system. If suited to the patient, hypodermic injections of morphia are of great service. After the second day free watery purgation by a table-spoonful of Rochelle salts, Epsom salts, or a bottle of citrate of magnesia, and a restriction of the amount of fluid taken into the stomach, are advisable, in order to limit the tendency of effusion into the pleural sac as far as possible. If the febrile movement runs very high, veratrum viride or aconite, in three to five drop doses of its tincture, may be given to reduce the pulse and heart's action, but this is rarely necessary. In the second stage after effusion has occurred, the chief indication is to reduce the amount of this serous liquid as speedily as possible, and for such a purpose diuretics and saline purgatives or elaterium, in quantities of half a grain every three hours, or so as to cause abundant watery discharges, may be given; counter irritation by iodine and small blisters being kept up over the diseased side of the thorax. If the liquid is effused in large amount and causes much interference with respiration, it may be necessary to draw it off by means of an aspirating apparatus. As the cure progresses tonics, good nourishing food, and early exercise in the open air in suitable weather, are highly important. In the treatment of chronic pleurisy and empyæma the great object is to get rid of the effusion, and although, if the symptoms are not urgent, general and local remedies, such as have been just referred to, may be continued, it is advisable not to postpone very long the direct removal of the fluid by aspiration, which should be performed slowly, and may be repeated if needful. In some cases a fistulous opening must be maintained for months or even years.

HYDROTHORAX is the name applied to that diseased condition where there is an accumulation of water or serous fluid in the cavity of the chest.

It may be the result of pleuritic inflammation, but not unfrequently occurs in dropsy without inflammatory action. Sometimes it increases to an enormous amount, pressing on the lungs and displacing the heart, with such great interference to the respiration and circulation as to prove the immediate cause of death, unless removed by aspiration as already described.

PNEUMOTHORAX is the term applied to the morbid state in which air has entered and partly occupies the cavity of the pleura, compressing the lung in the same way though less forcibly than does a watery effusion. This accident sometimes occurs from the rupture of the vesicles of the lung through the pleural membrane into the cavity of the pleural sac. At other times it results from some injury to the chest, such as a gun-shot wound or the fracture of a rib. Where closure of the aperture by which this air found an entrance can be secured, it may be necessary, in order to relieve the oppression of breathing, to pump out the air by means of the aspirating apparatus.

EMPHYSEMA or the accumulation of air under the skin in the subcutaneous connective tissue is a curious result occasionally met with from wounds of the pleura such as those produced by compound fractures of the ribs and other causes. This distension of the integument with air may progress until all semblance of humanity is lost and yet entire recovery takes place. It may almost always be prevented by proper attention to the primary injury.

The membrane of the pleura may be affected with cancer, simple tumors, tubercle, and parasitic growths, but these are very uncommon, except as secondary manifestation of extensive disease of the same kind in other portions of the body, in which cases the latter are consequently the proper subjects of whatever treatment becomes needful.

The space between the lungs, and bounded on each side by the two pleural membranes in which they are enclosed, is called the mediastinum. In rare instances it becomes the seat of cancer, abscess, or simple tumors, for the relief of which no effectual treatment has as yet been devised.

## CHAPTER XI.

### DISEASES OF THE DIGESTIVE SYSTEM.

IN considering the maladies of the digestive system frequent references must be made to the anatomy of the alimentary tract which is figured on page 144, and to the physiology of digestion, as explained on pages 145 to 148.

Among the common diseases of the lips are ulceration and fissure, which may often be induced to heal by light applications of nitrate of silver solution, in conjunction with diligent improvement of the general health. Cancer of the lip is not uncommon among men in advanced life, but is less frequent in females. It should be operated on in accordance with the rules already laid down on page 391, in discussing the subject of cancer. Hare-lip is a curious malformation, in which the upper lip has failed to develop in such a way as to unite in the centre previous to birth, and the child is left with a deep cleft, sometimes reaching all the way from the edge of the nostril. This malformation can generally be remedied by a surgical operation.

#### STOMATITIS OR INFLAMMATION OF THE MOUTH.

This is commonly met with in young infants, and is called "baby's sore mouth." It consists of a superficial inflammation of the mucous membrane of the mouth and tongue, probably the result of the first development of the minute organisms which grow there, and thrive for the rest of the life of the individual without causing any irritation after the parts become accustomed to their presence.

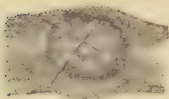
*Treatment.*—The disease is generally insignificant, and may be treated by dusting the affected portions with equal parts of finely powdered borax and white sugar. The follicular stomatitis occurring in persons of all ages may be generally cured by the same treatment. Chlorate of potash and sulphite of soda as mouth-washes and gargles, of the strength of a dram to four ounces of water, are also useful, and attention ought to be paid to improving the general health by the use of tonics, nutritious food, and so forth. Parasitic stomatitis or "thrush" is undoubtedly due to the growth of an irritating fungus, and in unhealthy children appears capable



of progressing to the dangerous or fatal canker of the mouth, called also gangrenous stomatitis, to which local applications of the pernitrate of iron, painted on with a brush, should be made early in the attack. The development of thrush over the whole lining membrane of the mouth, tongue, and throat, is very common shortly before death in wasting diseases, such as consumption, and is a very unfavorable sign. Abscess of the mouth sometimes occurs, and cysts, such as that commonly termed ranula, produced by the obstruction of one of the salivary ducts under the tongue, are occasionally met with.

The diseases of the gums generally require the care of a dentist, and when connected with affections of the teeth, or their sockets in the alveolar processes, are usually so painful that prompt application to a dental practitioner is made. Inflammation of the gum, conjoined with ulceration at the root of a tooth, gives rise to horrible suffering which lasts for three or four days, when it is usually relieved by the discharge of matter or pus. The pain can be somewhat mitigated by anodynes, such as ten grains of Dover's powder or one-sixth of a grain of morphia, and poultices, but the best treatment is the extraction of the offending tooth, or the perforation of the alveolar process to the seat of trouble by drilling a hole through the spongy bone. An abscess or gum-boil is sometimes followed by ulceration, which may be hard to heal unless the whole cause of the difficulty is removed, which can now be accomplished under nitrous oxide gas so quickly, painlessly, and safely, that no time should be lost in resorting to it. One extremely skillful operator in Philadelphia has now administered the gas for operations on the teeth in over one hundred thousand cases without a single fatal result. Hypertrophy and atrophy of the gums are sometimes met with. A very common cause of diseases of the stomach and bowels, and also of convulsions in children, is to be found in the hardening or induration of the gums at the time of teething, and this blunder of nature's ought to be promptly remedied whenever the gums in infants at the time of the first dentition are found to be red, swollen,

FIG. 42.



LANCING THE GUM  
IN DIFFICULT DENTI-  
TION.

and hot to the touch, by the use of the lancet. This little operation of lancing the gums, which simple as it is, has probably saved the lives of thousands of young children, should be performed as indicated by the accompanying illustration whenever the gums present the appearance there exhibited. After the incisions are made bleeding should be encouraged, but care must be taken by wiping it off with a handkerchief to prevent the infant from swallowing the blood. It is astonishing what relief is often afforded to the little sufferer by a timely lancing of the gums. Tumors of various kinds sometimes make their appearance upon the gums, the most common of those which are non-malignant being the fibrous growths called epulis, often apparently caused by the irritation of

diseased and neglected teeth. They all usually require surgical operations for their removal. Perforation of the hard palate or roof of the mouth is sometimes a malformation present from birth, and due to the same kind of arrest of development as hare-lip. At other times it may be due to venereal or scrofulous disease. A dental surgeon can do much to cure this deformity by operation, or to remedy the defect if incurable by surgical appliances, which substitute most ingeniously the deficient portions of the mouth.

The tongue is subject to almost all the diseases already spoken of as affecting the inside of the mouth, for which similar treatment is required. Troublesome little ulcers on the tongue can often be promptly cured by holding in contact with the sore a pinch of powdered borax for ten or fifteen minutes. Deeper ulcers may require touching with the solid nitrate of silver, and if dependent upon the constitutional taint of syphilis will be very difficult to heal without the use of internal remedies also. Cancer of the tongue appears sometimes to have its origin late in life from the local irritation of the stem of a pipe in habitual smokers, or from the sharp corner of a broken or isolated tooth. Hence it is important to avoid these exciting causes as much as possible. The operation for removal of cancer when seated in the tongue is more justifiable than almost any other, because, if recurrence should take place in the glands of the neck, or still better, in some internal organ, death comes to the victim in a much less painful and horrible form. For such a surgical proceeding, and indeed for all operations upon the mouth, face, and throat, the new method of producing anæsthesia or insensibility to pain, by injecting the vapor of ether into the rectum appears to offer very great advantages.

Tongue-tie is a malformation in which, from the prolongation of the little membranous band, called the frænum, underneath the tongue, the organ, even to its very tip, is in some cases tied down to the lower jaw. If, as occasionally happens, it interferes with a baby's nursing, it should be operated upon the next day after birth by nicking the band at the front edge, and then tearing it back to about the usual position. No cutting operation should be resorted to, except in this very superficial way, on account of a very active little artery which lies at the root of the tongue, and which, if wounded, might bleed so as to endanger an infant's life before the hemorrhage could be checked. On this account, if nursing is not seriously interfered with, it is better to wait some months before thus untying the tongue.

## DISEASES OF THE THROAT.

Sore-throat, which may be considered as comprising inflammation of the mucous membrane lining both the fauces and the pharynx, as they nearly always occur together, is one of the commonest disorders. It is

occasionally produced by attempting to swallow some irritating article of food, or poison, but is ordinarily the result of cold. It also occurs in the course of various febrile affections, such as scarlet fever. The symptoms are pain on swallowing, redness of the surface, and at first dryness, but after a day or two later, excessive secretion from the mucous membrane. Subsequently to partial recovery from an acute sore-throat, the condition may be one of relaxation, the membrane remaining loose and flabby, and often thrown into projecting folds. This state usually follows cold and sore-throat, but may be induced by mechanical causes, such as severe, hoarse cough, screaming, shouting, or over-straining in reading or singing. It may also be brought on by excessive smoking. One form of this malady, called clergyman's sore-throat, is the result of excessive use of the voice in church service when the health is already impaired, especially when the air of the apartment in which such exertion is made has been rendered impure by overcrowding. In bad cases of sore-throat, the inflammation may go on to ulceration, especially if neglected. The generally relaxed condition of the throat is partaken of by the uvula, or palate, as it is incorrectly called by many people, and this hanging down lower than it ought, may cause a hacking cough by tickling the epiglottis.

*Treatment.*—The treatment of inflammation of the throat is rendered to a certain extent difficult by the impossibility of keeping any application constantly in contact with it. On this account lozenges, gargles, and sprays, employed very frequently, are the most available means of medication. For the first day or two of an attack soothing and anodyne gargles, with lozenges of chlorate of potash, containing three grains each, are useful. A little later, astringent gargles, containing alum, borax, or tannin, in the proportion of one or two drams to eight table-spoonfuls of water, and a table-spoonful of paregoric if there is much pain, may be employed with advantage; but unless care is taken to avoid a new exposure to the cause, by venturing out into cold or damp air too soon, sore-throat is sometimes very obstinate and difficult to cure. Attention to the general health is important, and iron, quinine, and strychnia, as directed when speaking of anæmia, are often needful for the cure of those numerous cases where the throat affection is rather a local expression of deteriorated health than an individual disease. In chronic sore-throat, solutions of nitrate of silver, of from ten to twenty grains in an ounce of distilled water, frequently prove useful, and in chronic elongations of the uvula, may be employed after applications of dry, powdered alum, or of tannic acid, have failed. Occasionally the tip of the uvula must be snipped off, in order to cure the troublesome cough to which it gives rise. Syphilitic ulcerations of the throat require, of course, appropriate specific treatment, and cancerous and other growths may render surgical interference necessary.



**QUINSY OR INFLAMMATION OF THE TONSIL.**

This disease is a cause of great suffering to some persons in youth and middle age, but is rare in childhood, and often ceases its molestations after individuals commence the decline of life. Exposure to cold and wet are its common exciting causes. In the catarrhal form of quinsy the inflammation is often superficial, and after causing much pain and difficulty of swallowing, subsides in three or four days without suppuration. In the severer variety an abscess or boil forms in the substance of the tonsil, attended with great pain and swelling, difficulty of swallowing, a good deal of fever, and some loss of strength. The patient often suffers from ear-ache, and is somewhat deaf on account of the inflammation extending along the Eustachian tube. The breathing through the mouth is much interfered with, but the danger of suffocation is apparent only. The disease lasts on an average about seven days, but the abscess may break on the fifth day, or may linger until the tenth day, unless earlier opened by the lancet. The complaint is very apt to recur, and the sufferer from one attack rarely escapes without several every winter, until the tendency, which may be hereditary, is exhausted.

*Treatment.*—The treatment consists in an effort to abort the disease by leeching, externally, and the use of guaiacum in tea-spoonful doses of the tincture four times daily, by the mouth. If these remedies fail, poultices of little bags of hops dipped in hot vinegar and sprinkled with laudanum, and hypodermic injections of a quarter of a grain of morphia, may afford some relief. When suppuration is established, the period of suffering can be abbreviated by lancing the swelling in the throat, provided the spot where the abscess points is high enough to be felt by the finger. The operation is performed by having a long, narrow-bladed knife wrapped with sticking-plaster, to within a quarter of an inch of its point, and then passing this down the throat, guarding it with the finger, and guided by the touch, as the patient can rarely open the mouth wide enough to admit of seeing, a small incision is made into the softened portion of the tumor. The relief afforded either by puncture in this way, or by spontaneous rupture, is wonderfully great. No after-treatment is necessary; but, as before mentioned, the complaint is very liable to recur, and it often happens, that in persons who are strongly predisposed to it, the first imprudent exposure on venturing out will light up the disease in the opposite tonsil, with an almost exact repetition of the suffering, within two weeks.

**DISEASES OF THE CÆSOPHAGUS OR GULLET.**

Inflammation of the gullet is a rare affection, and is usually due to swallowing some hot or corrosive liquid, although it may occur from the

extension of simple or erysipelatous inflammation from the throat, or of the former variety from the stomach. Ulceration is also uncommon, although it does occur in connection with syphilitic complaints. The most frequent form of disease in the gullet is stricture, of which there are several varieties. Spasmodic stricture is a narrowing of the tube, caused by simple contraction of its muscular fibres. This condition is especially met with in hysterical females, and, though alarming at the time, seldom proves fatal to life. Traumatic stricture is the variety in which the constriction has been caused by irritation and inflammation due to an injury inflicted on the surface of the tube, in any part of its length, by the swallowing of scalding water or of some corrosive substance, or by a wound. The result of such a stricture is to render the act of swallowing always difficult, unless relieved by a surgical operation. A simple organic stricture is occasionally seen, in which there is a mere narrowing of the gullet, without any apparent tendency to ulceration. The most common and fatal form of stricture is that due to cancerous deposit and ulceration. It may cause death by producing a complete obstruction, so that neither food nor drink can enter the stomach, or by ulcerating into some of the adjoining vital structures. The surgical operations sometimes performed for its relief are of very doubtful benefit or propriety.

### GASTRITIS OR INFLAMMATION OF THE STOMACH.

The simplest and most common form of inflammation of the stomach is characterized by active congestion and excessive secretion of mucus, a condition known under the name of gastric catarrh, and very similar to that so frequently met with in the throat and air-passages. The causes of this malady are indigestible food, especially in children, irritant poisons, or alcoholic excess. But it may occur in connection with gout or as a symptom in some of the eruptive fevers. The indications of acute gastritis are pains, which are often severe over the pit of the stomach, shooting through to the back, and increased by taking food, but temporarily relieved by vomiting. Tenderness over the pit of the stomach is always present, and nausea and vomiting are prominent symptoms, the vomited matter consisting of a glairy mucus, stained with bile of a greenish-yellow or bright green color. The tongue is coated with fur, whilst the edges and tip are frequently red and irritated. The bowels are apt to be confined, and the urine scanty and high colored. These symptoms often set in with chilliness, followed by restlessness, hot skin, headache, and other febrile symptoms. In bad cases there may be great prostration, with cold, clammy skin, a weak, rapid pulse, some difficulty of breathing, and obstinate hiccough. Generally, however, under proper management, these distressing symptoms subside after a time, although they sometimes pass into those of the chronic form of gastritis.

*Treatment.*—The treatment of this disease is, in the first place, if consequent upon the introduction of some poison or irritating material, to get rid of the offending substance by means of an emetic, followed by a purgative, which is perhaps in most cases best administered by enema. The food should be entirely liquid, and given in very small quantities; in fact, most cases would do better if nutritive injections were depended on to sustain life for a few days or a week or two. The thirst may be relieved by sucking small pieces of ice, but iced champagne is sometimes borne by the stomach when everything else is rejected, and iced carbonic-acid water is often acceptable. With the exception of subnitrate of bismuth, in quantities of five grains, and drop-doses of diluted hydrocyanic acid, it is usually advisable not to provoke the irritable stomach with medicines, the hypodermic injection of morphia being used to relieve pain, if the patient can take morphia, or morphia and atropia, in doses of one-eighth of a grain of the former and one-one-hundredth of the latter in that way without nausea being produced. Thin and light poultices, as, for instance, of flaxseed meal and laudanum, laid over the region of the stomach, are frequently of service, or if the pain is very severe a few leeches may be applied. Convalescence from this malady is generally slow, and requires great care in regard to diet and exertion.

Chronic gastric catarrh, sometimes called irritative dyspepsia, may arise out of an acute attack of gastritis, or more commonly develops gradually as a result of repeated and persistent errors in diet, imperfect mastication of food, congestion of the portal veins from obstinate constipation or other cause, and from organic diseases of the stomach. It is distinguished from simple dyspepsia by the greater amount of discomfort over the gastric region, accompanied by tenderness on pressure, by the existence of thirst, by the greater frequency and constancy of acidity, heartburn, water-brash and vomiting, and the greater severity of the constitutional symptoms. Following out the general rule of treatment the great point in managing chronic gastritis is to find out the cause and prevent its recurrence. In the early stage the remedies employed may be those already suggested for use in the acute form, but later oxide or nitrate of silver, in half grain doses three times daily, with a quarter of a grain of extract of nux vomica, is beneficial, and after the digestive organs become less irritable, quinine, iron, and the mineral acids come into play.

### ULCER OF THE STOMACH.

This remarkable disease is attributed to the corroding action of gastric juice on the very membrane which has secreted it, in consequence of the vitality of that membrane becoming impaired by thrombosis of some small artery in the wall of the organ. A simple gastric ulcer is round or oval, about one-quarter to one-half of an inch in diameter, with thin,



clean-cut margins as if punched out, but deepest in the centre, like a shallow funnel, though varying in depth from a mere destruction of the mucous membrane to complete perforation of all the coats. It is usually single and most commonly situated at the back of the organ near its lower or pyloric orifice. The ulcer may happen to eat into some large blood-vessel, in which cases serious or fatal hemorrhage is apt to occur. The terminations of such an ulcer are the favorable one of its healing up with or without puckering in the wall of the stomach, or, on the other hand, of perforation, which may occur with the escape of the contents of the stomach into the peritoneal cavity. Such an accident is generally followed by peritonitis and almost certain death. The symptoms of gastric ulcer are pain and tenderness over the pit of the stomach, this pain coming on shortly after taking food, and increasing until the organ is emptied by vomiting. Sometimes the distress seems to extend through into the back. The seat of tenderness coincides with that of pain, and is localized over a comparatively small surface. Vomiting of blood occurs in about one-third the cases, and though not so frequent as in cancer, is much more profuse. Vomiting of food half an hour or an hour after eating is usual, and various dyspeptic symptoms are met with. The pain is often described by the patient as of a gnawing character, and is commonly made worse by condiments, animal food, saccharine substances, and alcohol; whilst the pain in neuralgia of the stomach is frequently relieved by these articles of diet.

*Treatment.*—The most successful treatment of gastric ulcer is perfect rest in bed and nourishment entirely by nutritive injections, for a period of from one to three weeks, or until the subsidence of the pain and tenderness indicate the healing of the ulcerated spot. Prussic or hydrocyanic acid and bismuth, as directed in gastritis, may be given to control vomiting, and morphia hypodermically, guarded if needful by atropia to relieve pain. Small blisters over the stomach are frequently useful, and the first food administered should be lime-water and milk in very small quantities, gradually increased as the power of the organ to retain food is found to be restored. If vomiting of blood comes on, perfect rest, the quieting of the peristaltic motion of the stomach and whole digestive tube by full doses of a grain every two hours of opium, or one-sixth of a grain of morphia, and the use of acetate of lead by the stomach in quantities of two grains every three hours, tannic acid and gallic acid by enema, and five grains of ergotin hypodermically, are to be resorted to. Ice in small pieces may be given frequently, and cold cloths applied over the gastric region. Alarming as this profuse hemorrhage is, it very often does not prove fatal.

### CANCER OF THE STOMACH.

The stomach is one of the most frequent seats of cancer, which is especially apt to attack this organ in men advanced in life who have subjected their digestive apparatus to more or less constant irritation. The tendency is very often hereditary. The cardiac end of the stomach is generally the seat of epithelial cancer, and the pyloric extremity of hard cancer or scirrhus. Its tendency is to extend around the organ, and hence it leads to an annular or ring-like constriction. The symptoms are those of gastritis or mere dyspepsia at first, but after a few weeks or months, in a majority of instances, a small amount of blood is vomited, and serves to indicate pretty clearly the true nature of the case. The blood in cancerous hæmatemesis of this kind being effused slowly and in small quantity is altered by the action of the gastric juice so as to present a brown color. This tint and the minute clots in which it appears have caused the expressive name of coffee ground vomit to be applied to it. Although not an infallible sign, it constitutes one of the surest early evidences we possess of the existence of cancer of the stomach. This disease is distinguished from gastric ulcer, which it most resembles, by its occurrence in advanced life instead of in the young; by the presence of a hereditary predisposition; by the character of the hæmatemesis; by the greater diffusion of the tenderness; by the constancy of the pain; by the cancerous cachexia, and, as emaciation advances, by the increasing tumor, which can be distinctly felt in most cases through the thinned walls of the abdomen. The average duration of cancer of the stomach is from six months to one year, and it always proves fatal.

*Treatment.*—Treatment can be only palliative and carried out on the general principles laid down when speaking of chronic gastritis and ulcer of the stomach. The surgical operation of cutting out the diseased part of the stomach being in the writer's opinion unjustifiable.

### DYSPEPSIA.

This affection, the great torment of civilized life, is to be considered rather as an unnatural functional difficulty than as a structural disease. Among its three chief varieties may be mentioned, first, the form due to sympathetic relations with other organs which are themselves in a morbid state, and which is therefore explainable as a reflex action. Of such a type is the nausea and occasional vomiting which attends irritation of the brain, lungs, liver, or uterus. Sea-sickness is believed to be a form of this reflex dyspepsia. The second form is attributable to a scanty secretion of gastric juice, and is characterized by slowness of digestion, long retention of food in the stomach, prolonged distress after eating, especially with feelings of weight and uneasiness at the pit of the stomach,

a tendency to decomposition of the food in the alimentary canal with the evolution of fetid gases and the appearance of undigested food in the evacuations from the bowels. The food may be considered to be delayed in the stomach when it remains there for more than two or three hours. Dyspepsia of this kind is often inherited, but much can be done to aggravate the tendency by mental over-exertion, prolonged and intense anxiety, especially if commencing directly after meals, sedentary habits, gluttony, and the use of alcoholic and other stimulants. The third form of dyspepsia appears to be owing to some abnormal quality of the gastric juice, and to diminished peristaltic movement of the stomach, so that food is not sufficiently mixed up with the digestive fluids. One of the most characteristic symptoms of this condition is pain at the cardiac end of the stomach, to which the name of cardialgia has been applied, on account of the distress being in such close proximity to the heart. Many dyspeptics, being also more or less hypochondriacs, imagine from this symptom that they are subjects of organic disease of the heart, and suffer intense, yet groundless, mental anxiety on that account. The names of heart-burn, pyrosis, and water-brash, are applied to slight modifications of this symptom. Tobacco contains a poisonous principle which in many persons favors the development of dyspepsia, and some individuals suffer from smoking even a single segar. Inability to absorb liquids occurs in some varieties of dyspepsia, so that fluid which has been swallowed may be heard splashing around in the gastric cavity on any forcible agitation of the body, the stomach being usually distended to a great extent. As further aids in distinguishing between dyspepsia from deficient secretion of the gastric juice, and deficient motion of the stomach, it should be remembered that in the former neither flatulence nor constipation are generally present, whilst in the latter variety flatulence is one of the most characteristic symptoms and constipation is usually well marked. Some of the worst cases of dyspepsia from deficient secretion of the digestive fluid, in which pain after taking food, and other symptoms are particularly severe, appear entirely free from flatulence. The tendency of the fermentation which goes on in the slowly digesting food seems to be of a kind in which gases are not evolved. In all these forms there is a loss of appetite. The tongue is usually broad, pale, and flabby. The pulse is weak, soft, and compressible, and palpitation of the heart frequently occurs. There may be dyspnoea on exertion and a short dry cough, the stomach-cough of the older authors. The general nutrition, of course, suffers, and the face is pallid and bloodless to a greater or less degree.

*Diet*—The treatment of dyspepsia must be chiefly dietetic, although medicines are not powerless in this complaint. In the first place all indigestible food, such as pork, veal, and salt meats, and richly made dishes, such as pastry of every description, ought to be avoided. In the acid forms of dyspepsia which are connected with deficient muscular



movement pastry and saccharine substances are particularly harmful, and vegetables and fruit should be partaken of sparingly. In some instances an exclusive milk diet, persevered in for some weeks, has appeared to produce marvellously good results; but, except under such a regimen, water ought to be the habitual drink. Cocoa, deprived of its fatty ingredients, is often much to be preferred to tea and coffee, and these accessory foods, if taken at all, should be weak, cool, and well diluted with milk. Rich or effervescent wines should be avoided, but the lighter Rhine wines or ale, or extract of malt, are often useful in atonic dyspepsia, with impaired movement of the digestive organs. In order to improve the general health all the agencies which favor the improvement of the nutrition and enrichment of the blood, such as abundant exercise in the fresh air, tepid or cool bathing, and warm clothing should be pressed into service. The successful prescription of a famous English physician to a rich and indolent patient who came to him complaining of the tortures of dyspepsia was, "Go and live on a shilling a day and *earn it*."

*Treatment.*—In the medicinal treatment for dyspepsia accompanied by undue acidity, as evidenced by the frequency of heartburn, if the urine is scanty and lets fall an abundant deposit, alkalies, such as the bicarbonate of soda or potash in quantities of ten to twenty grains thrice daily, are useful, and are best taken three or four hours after a meal. In acidity with anæmia and debility, mineral acids, such as the diluted nitro-hydrochloric in five drop doses, serve the purpose better. Vegetable bitters, of which columbo in doses of a wine-glassful of the infusion thrice daily generally proves the mildest, and nux vomica or strychnia, are good digestive tonics, and in slow digestion benefit is sometimes derived from very minute doses of ipecacuanha. For vomiting, besides the remedies already spoken of under gastritis, very small quantities of Fowler's solution of arsenic, in two drop doses, or creasote mixture may be tried. For flatulence the aromatic carminatives, such as ginger and cardamon, and powders of two grains each of charcoal with bismuth, also counter-irritation by means of small blisters over the stomach are often of great service. When the secretion of gastric juice is scanty, pepsin or lactopeptine, in quantities of ten grains, frequently proves itself invaluable as an aid to digestion.

### ENTERITIS OR INFLAMMATION OF THE BOWELS.

This disease is not very common, but may arise from taking cold, from the abuse of purgatives, from swallowing irritant poisons, and from peritonitis. Its symptoms are diarrhœa with pain, often very severe, increased on pressure and most intense about the navel or in the right flank. The frequent discharges temporarily relieve the griping pains, which, however, soon return. The pulse is excited, generally full and strong, and marked fever is present.

*Treatment.*—The treatment is by anodyne fomentations or poultices to the abdomen, such as the flaxseed poultice with laudanum, and grain doses of opium by enema or suppository. Rest in bed must be strictly enjoined.

### TYPHLITIS.

TYPHLITIS is an inflammation of the cœcum or head of the large intestine (see figure on page 144), in which indigestible food, and especially the seeds of grapes and raisins, particularly in children, are apt to get fast and cause this dangerous disease. The symptoms are severe griping pains in the right flank, great tenderness on pressure, and accumulation of large amounts of hardened excrement in the intestines, which seem to become to a considerable extent paralyzed and powerless to expel their contents. The inflammation is very apt to go on to the formation of abscess, which may either open into the bowels, or make its way through the walls of the abdomen, generally a little above the groin. This malady, which is a very tedious, painful, and dangerous one, is fortunately not common, and could probably be rendered extremely rare if people, and especially children, would avoid swallowing any hard angular substances which could mechanically give rise to such trouble.

*Treatment.*—The treatment is by gentle laxatives, such as small doses of castor-oil, and large enemas introduced high up by means of a long nozzle to the syringe employed. Leeches may be applied if the pain in the flank is severe or persistent, and followed by cloths soaked in laudanum, or flaxseed poultices containing anodynes. Cases have been reported in which concretions of carbonate or calcined magnesia formed in the cœcum gave rise to this complaint, so that an insoluble substance of this kind ought not to be too long continued as a purgative or antacid.

### DYSENTERY.

This is a febrile disease, characterized by severe colicky pains, followed by straining, which results in scanty mucous or bloody stools, containing little or none of the natural faecal matter or excrement. It is especially met with in tropical climates, where it is thought by some to be an infectious malady. An ordinary attack of acute dysentery usually commences with diarrhœa, but in from twelve to twenty-four hours disagreeable feelings begin to attend the frequent loose discharges from the bowels, such as irregular griping pains along the course of the large intestine, described as shooting or cutting, and momentarily relieved by the evacuations. After a short time the distress extends upwards, until the whole abdomen becomes painful. With frequently returning inclination to go to stool the griping and straining continue, without the suffering patient being

able to pass anything more than a little bloody mucus. These symptoms are aggravated during the night and early morning, and leave behind them the tormenting sensation that there always remains in the bowels something which has yet to be discharged. This sensation, which is technically called tenesmus, increases, and ultimately becomes the most striking feature of the disease. When the malady is fully established, the evacuations consist of bloody slime, sometimes tinged with bile, and containing shreds of membranous-like exudation thrown off from the interior of the bowels. They exhale an odor almost peculiar to dysentery, very offensive and yet quite different from that of ordinary fæces. This complaint may prove fatal in consequence of the great loss of blood, but it more commonly causes death by wearing out the patient. When a fatal termination threatens, the symptoms assume a typhoid character, with great prostration, dry, brown tongue, hiccough, and vomiting. In favorable cases improvement begins about the end of the first week, but convalescence is usually very protracted, and many cases stop half way, as it were, continuing to suffer for months or years with the chronic form of the affection. This disease is very common among young children, being especially prevalent and fatal among those who are cruelly kept in cities during the hot summer months, and it is the usual result of starvation or deterioration of food, especially if long continued and accompanied by hardship and privation, being then an extension of the diarrhœa which is apt to be first produced.

*Treatment.*—The treatment in the acute form consists of large doses of ipecacuanha, of twenty to thirty grains, given in small quantities of fluid, with or without a grain of opium; perfect rest in bed, and the strictest attention to diet. After the more violently acute stage has passed, laudanum injections, or opium by suppositories, with such astringents as two grains of acetate of lead, half a grain of nitrate of silver, and of sulphate of copper combined with small doses of a quarter or half a grain of opium by the mouth, are generally beneficial, but care must be taken not to check the disease too suddenly by the use of these remedies. The diet, as pointed out before, should consist of the blandest and most unirritating substances, such as boiled milk with lime-water, beef essence, boiled rice, and if the debility is extreme, raw eggs beaten up with milk. Stimulants should not be administered unless absolutely necessary, on account of their locally irritating effect.

## DIARRHŒA.

In many cases this common malady is also rather a consequence or symptom of some morbid condition, than itself a disease. The frequent discharge of loose or fluid evacuations from the bowels, without griping pain or tenesmus, is sometimes a wise effort of nature to get rid of some



injurious or indigestible material, which has been imprudently swallowed into the stomach and has from there passed into the bowels. Diarrhœa may likewise be produced by some violent mental impression, or by exposure to taking cold, the bowels instead of the throat being often the weak spot of the individual. It also results from privation of food, food of poor quality, and many analogous causes.

*Treatment.*—In the treatment of diarrhœa from indigestible food no attempt should, as a rule, be made at first to check it until the offending material, whatever it may be, is cast out of the system. In fact, a gentle and soothing laxative, such as a dose of castor-oil with a few drops of laudanum, to hasten along the conservative action of emptying out the intestinal canal, is often of great service. *After* this is accomplished, however, each additional evacuation is an evil, which should be prevented by the use of five grains of bismuth or chalk, with three grains of tannic acid, or in a tea-spoonful of either syrup of galls, or syrup of krameria, and a quarter of a grain of opium, or by opiates combined with carminatives like lavender, or ginger, and camphor, a good mixture being ten drops of laudanum, fifteen of compound spirits of lavender, and five of spirits of camphor, taken on a lump of sugar every hour or two until relieved. If the stomach is unsettled, as is frequently the case, the opiate and astringent may be administered with advantage by enema or suppository, and in patients who cannot, or think they cannot, retain medicines in either the stomach or rectum, hypodermic injections of the eighth of a grain of morphia may often be resorted to with the happiest effect. A good rule in taking a diarrhœa mixture is to use a moderate dose every two hours, provided the loose passages recur within that time, but if at the end of two hours there has been no liquid or semi-liquid evacuation in the interval, to wait until such a one occurs before resorting again to the remedy. In this way the blunder of so overdoing the good work of checking the diarrhœa as to inflict upon the system its opposite evil of constipation may generally be avoided. The patient thus gains from the remedy all the good with as little of the necessary evil, which lurks in the bottom of every cup of blessing, as possible, a desideratum which should constantly and persistently be kept in view in every kind of medical treatment, as well as all other affairs of life.

Among the various other valuable remedies often beneficial in this exceedingly common disorder, may be mentioned the tincture of kino, catechu, and logwood, acetate of lead, sulphate of copper, and sulphate of zinc, nitrate of silver, spirits of chloroform, tincture of capsicum, spirits of camphor, compound spirits of lavender, and so forth.

In cases of diarrhœa, where the tongue is white and coated, the pulse accelerated, the temperature a little raised, and some pain or soreness, increased by pressure, is felt in the abdomen, small doses of Epsom or Glauber's salts, in conjunction with hyoseyanus and opium, and per-

fect rest in bed with the most rigid attention to diet, are necessary, lest the slight irritation of the mucous lining of the alimentary canal, become aggravated into actual inflammation, and more serious disease, such as dysentery, enteritis, or obstinate chronic diarrhœa result.

*Diet.*—The diet of a person suffering from diarrhœa must be very strictly regulated, and, in fact, nothing but tapioca, sago, boiled rice, or milk-toast with boiled milk, twice-boiled water, beef-tea, and table-tea, should, as a rule, be put into the stomach. Even after the malady seems to be cured, much caution must be exercised about returning to the ordinary diet. This disease, like most others indeed, exhibits as it passes away a singular analogy to a conflagration, which for days after it has apparently been extinguished is ready to break out again, if the remaining sparks happen to be fanned into a flame by the wind or any new fuel is supplied.

### CONSTIPATION OR COSTIVENESS.

This diseased condition, the direct opposite of the preceding one, may be defined as a retention of the fœcal matters, beyond the usual period, so that they are passed with difficulty, and in a comparatively hardened state. The causes of constipation are almost infinitely various. Every form of impaired digestion may originate it; the existence of piles or hemorrhoids, a sedentary life, application to study, amenorrhœa, and uterine disease in females, all are apt to induce it, and almost every acute disease is frequently ushered in by constipation. It is more often met with among women than men, probably because the female sex fail to exercise sufficiently in the open air; and many articles of food largely contribute to establish the evil of habitual constipation.

*Treatment.*—If the trouble be occasional and accidental, any of the milder laxatives, such as a table-spoonful of Epsom or Glauber's salts, Rochelle salt, castor-oil—which is the safest purgative, as a rule—ten or fifteen grains of rhubarb, senna, or the various purgative mineral waters, may be employed. For some patients, injections of warm water, or soap and water, answer a very good purpose, and if administered with care are perfectly harmless.

Habitual constipation is best treated by the regulation of the diet, partaking of fresh or stewed fruits, bran bread and vegetables in season, in proportions sufficient to antagonize the torpor of the bowels; at the same time resorting to active exercise in the open air, and endeavoring to correct any faulty habit of life, which may be the primary cause of the trouble. If the difficulty had its origin in hereditary tendency, or other deep-seated modification of the organism, laxatives should be resorted to, because, in the writer's opinion, at least, the evils of constipation are far greater than those arising from the constant employment of these



medicines. It is probable that for most persons saline laxatives, such as Rochelle salts, or purgative waters during the summer, and in cold weather pills of a grain of rhubarb, one-sixth of a grain of podophyllin, and a grain of compound extract of colocynth, tea-spoonful doses of the compound liquorice powder, or some of the many excellent gentle laxatives recommended in the pharmacopeia, best serve the purpose. Obstinate constipation, that is, absence of evacuation for several days, or a week or two, is a dangerous condition, and should never be permitted to occur, since the large and densely-packed masses of feces may require the operation of drastic cathartics to dislodge them, and such medicines, in accomplishing their work, sometimes set up serious or fatal inflammation. Liberal potations of castor-oil, aided by large enemas, may first be tried in such a case; then senna, in tea-spoonful doses of the fluid extract; then quarter- or half-grain doses of tartar emetic, in conjunction with Epsom salts, and if these fail, it may be necessary, under skillful advice of a physician, to resort to drastic cathartics, such as gamboge, calomel, elaterium, and croton-oil, provided no organic obstruction exists.

Obstruction of the intestine may be the result of stricture, intussusception, or internal strangulation, these latter being fortunately rare. Spasmodic stricture is sometimes the result of irritation, which can be relieved by anodynes; it also occurs in hysteria. Stricture of the bowel is likewise the occasional result of ulceration, or of the development of cancerous growth, which, of course, is almost certainly fatal, as already explained.

Intussusception is the slipping of one portion of the intestine into another portion, as the upper part of the finger of a glove sometimes slips into the rest in pulling it off the hand. It is very dangerous, and generally proves fatal. Some cases have been relieved by injecting large quantities of water, or preferably air, in the hope of so distending the bowel as to push back the part that has slipped into the section of the tube below it. The chance, however, is small, and so is that from opening the cavity of the abdomen and trying to pull back the invaginated part; so that often all that can be done is to relieve the horrible pain with anodynes and inhalations of ether, as advised in the article upon gall-stone, until death relieves the sufferer.

Internal strangulation of the intestines occurs when the bowel is so tightly compressed that the circulation through it is checked, and mortification is threatened or actually results. It may be so compressed by the slipping of a knuckle of the intestine through one of the openings often existing in the thin membrane called the mesentery, which supports the bowels, or in the extension of the mesentery, called the meso-colon. In either form, the strangulation is due to the pressure or pinching of the swollen gut by the sharp edge of the opening, into which the fold of bowel has slipped. The symptoms are those of obstruction from hernia or rupture (for which see below). It is almost necessarily fatal, unless



recognized in time to allow of successful opening of the abdomen, and releasing the nipped knuckle of bowel before it mortifies.

### HERNIA OR RUPTURE.

Hernia is the name usually applied to the protrusion of some portion of the bowel through the wall of the abdomen. Thus we may have umbilical hernia or protrusion of the bowel at the navel, a form often seen in children; and hernia in the groin or inguinal hernia, which is probably the most common variety. It has been estimated that about one man in every seven is affected with hernia, but in most cases the intestine is kept in its place more or less perfectly by some form of truss. When a hernia can be pushed back it is called reducible. An irreducible hernia cannot be returned into the cavity of the abdomen, and is constantly in danger of being inflamed, by some accidental blow for instance, and so becoming strangulated. When this happens, unless relieved by cutting down through the flesh of the groin to the bowel, and then nicking the constricting membrane, it quickly proves fatal. The operation is itself very perilous, and only justifiable because if it succeeds it rescues the patient from agonizing suffering and almost certain death. The symptoms of strangulated hernia are intense pain, not only in the neighborhood of the rupture but over the whole abdomen and especially around the navel, obstinate vomiting, and cessation of the passages from the bowels. At first there may be one or two evacuations of the fecal matters already below the seat of strangulation, but after that is cleared out the bowels cease to move, and if the strangulation is unrelieved the vomiting, which persists in spite of all remedies, results in bringing up fecal material through the throat. This is a very curious phenomenon, and seems to indicate that nature in her stupid zeal to get rid of digested materials, on finding that the usual avenue downwards is blocked, soon reverses the normal peristaltic movement and tries to evacuate the bowels through the mouth. In accordance with this idea the importance of such stercoraceous vomiting, as it is called, in the diagnosis of strangulation of a hernia, or some similar obstruction, is very great. When it occurs, if undecided before, not a moment should be lost in sending for the best medical skill which can be procured, and which even then may arrive too late. In the absence of medical assistance reduction of an obstinate hernia on the point of becoming strangulated, or perhaps already compressed, may sometimes be accomplished by putting the patient in a warm bath, and so relaxing the system as already explained; or a full dose of opium or morphia, the former preferably by enema, may perhaps have the desired effect; or lastly, the administration of ether or chloroform, by one who is accustomed to giving these dangerous anaesthetics, by still more fully relaxing the system, may happily allow the endangered fold

of the intestine to be pushed back into its proper place. Hernia is sometimes produced or driven out under some treacherous truss, which should protect against such an accident, by very slight causes, all of which should be carefully guarded against by those who have any hereditary tendency to this disease. It may be forced out by a jerk, such as suddenly pulling open a door that sticks, or by a fall, by an attempt to lift a heavy weight or to raise a moderate one whilst in a constrained position, or any other act which tends to bring a strain upon the bowels making them bear downwards. It is also favored in its occurrence by over-eating, by excessively exhausting exertion, and by severe effort at times when the body is enfeebled by disease. It is more common on the right than on the left side of the body.

### INTESTINAL WORMS.

The intestinal canal is often the home of parasites, commonly called worms, and in many parts of the country nearly all children between the ages of one and seven years, as well as many older persons, are troubled with these pests. In childhood the usual inhabitant of the bowels is the round-worm or *ascaris lumbricoides*, a creature attaining the size of a large earth-worm, which it resembles in appearance, except that it is whitish or brownish, and stiffer and harder in its structure. Children are also often infested with the *oxyuris*, commonly called the thread-worm, pin-worm, or seat-worm. This parasite is sometimes found in great numbers about and just within the fundament. In size they are very nearly that of a very small pin, or piece of thread about half an inch long, but by their number and activity they often contrive to prove very troublesome guests to their unwilling host. The third common parasite which preys upon the human species is the *tania solium* or tape-worm, of which some account has already been given, see page 176. These parasites are always introduced into the system from outside, either with food or drink, and hence one great reason for the good cooking so strenuously urged in a former chapter. They are a great source of irritation as long as they remain, and in childhood, by the reflex irritation their movements in the intestines are capable of exciting, constitute one of the common causes of convulsions. Exactly what articles of food convey the eggs of the round-worms and the pin-worms into the human system has not yet been discovered, but the tape-worm is known to find its entrance into our bodies by the eating of raw meat, generally beef.

*Treatment.*—The remedies for the round worms are *santonin* in one grain doses to a child of seven years old, and *pink-root* in quantities of half a tea-spoonful of the fluid extract, which should be given to the little patient who has fasted for twelve or eighteen hours, so that the rascally thieves inside of him may be hungry enough to eat these drugs, which

act as poisons to them, plentifully and with avidity. Then in about three hours the vermifuge ought to be followed by an active cathartic, such as three grains of calomel and five or ten of rhubarb, or half a teaspoonful of fluid extract of senna, which will sweep away the parasites before those which are only half killed recover from the doses they have taken, and gain strength enough to crawl back again into the upper bowel.

The various symptoms supposed to indicate that a child has worms, such as itching at the nose, colicky pains, offensive breath, and gritting the teeth, whilst sufficient to arouse suspicion, are not reliable. Hence the only proof that a person is troubled with worms is seeing them come away, as they generally do under the action of a purgative, if existing in numbers sufficient to be troublesome. This test should always be resorted to in cases of doubt, taking care, of course, not to bring on improper irritation of the bowels.

*Treatment.*—To dislodge the pin-worms, which cause so much irritation and itching about the fundament, it is usually sufficient to administer a dose of castor-oil or other laxative, and directly after it operates to give an injection of strong salt-water, of lime-water, or of infusion of quassia, which sometimes will bring away multitudes of these active little parasites. To get rid of tape-worms some preparation is necessary, the patient being gently purged, and then kept on beef or mutton broth for a day or two. After this the emulsion of four ounces of pumpkin seed, the oil of male fern or kousso, should be administered, followed after twelve hours by a brisk purgative, such as five grains of calomel and ten of jalap, or three compound cathartic pills, which generally bring away the worm. When thus obtained it should be carefully examined in order, if possible, to find the head, which is at the small end of the creature and about the size of a pin's head. If this head has not been extracted the parasite will probably again develop in the course of a year.

### COLIC.

Colic is an acute spasmodic affection of the bowels without diarrhœa or much fever, but attended with severe cramps of the abdominal muscles. Its most common causes are indigestible food, reflex irritation from uterine or ovarian disease, and lead poisoning. The great characteristics of colic are the griping, twisting pains, radiating from the navel and relieved by pressure. Care must be taken not to mistake these pains for those of strangulated hernia, or the converse, which would be a much more serious blunder.

*Treatment.*—The treatment is to relax the spasm by opiates, and remove the offending material if there is any in the bowels. For the former purpose twenty or thirty drops of laudanum by enema or hypodermics of one-eighth of a grain of morphia, and for the latter a table-spoonful of castor-oil or a Seidlitz powder, answer very well in most instances.



### HÆMMORHOIDS OR PILES.

Hæmmorhoids or piles are exceedingly common and troublesome complaints, consisting of little tumors which form at the edge or just inside the fundament, and give rise to intense suffering, especially when the bowels are evacuated. Their production is favored by constipation, sedentary habits, hard seats, and some forms of liver complaint. Very often their surface, which in the internal variety is composed of the distended mucous membrane, exudes blood, in which case they are called bleeding piles. When seated outside the margin of the fundament they are not so apt to bleed, and receive the name of blind piles.

*Treatment.*—They may generally be prevented from developing by proper attention to the bowels, and, whilst small, an ointment of ten grains of extract of belladonna, thirty grains of tannin, and twenty grains of powdered opium in an ounce of simple ointment, will usually relieve them, but when of large size a surgical operation, which is not without danger, is the only cure.

### FISTULA IN ANO.

Fistula in ano is a very painful disease, in which a communication at the side of the fundament is opened through the flesh into the rectum, or lower bowel, above the sphincter or muscle which ordinarily keeps it closed. It is usually the result of an abscess at the side of the intestine. There are several varieties of fistula, in the worst of which the fecal matters from the intestines constantly leak out through the hole or sinus, and besides causing great irritation and pain, render the sufferer disgusting to every one whom he approaches. Most of these different forms of fistula can, however, be cured by severe surgical operations.

*FISSURE OF THE ANUS* is another painful affection, in which a slit or crack appears in the side of the fundament, often the result of a small ulcer at the edge of the opening. As it must be torn apart every time the bowels move it is very difficult to heal. Sometimes fissure of this kind can be cured by touching the sore with caustic, and using laudanum injections to keep the intestine in a state of comparative rest, but if these fail a surgical operation is the only remedy.

*PROLAPSUS ANI* or falling of the bowel is the coming down of the rectum, which protrudes outside of the body sometimes to the distance of three or four inches. It generally results from constipation, and is especially apt to occur in weakly and neglected children. The protruding portion of the intestine should be carefully and gently pushed back to its place with the fingers covered with a well-oiled silk handkerchief, and suitable apparatus obtained from the instrument-makers to keep it in position. Sometimes an operation is necessary.

## PERITONITIS.

This dangerous malady is an inflammation of the peritoneum or serous sac covering the intestines, liver, spleen, and so forth, and reflected upon the inner surface of the wall of the abdomen. It is probably more liable to become quickly and violently inflamed than any other structure of the body. Peritonitis is brought on by injuries, exposure to the air, and various other causes, the most common of which is the inflammation in the uterus following confinement, and constituting child-bed fever, which see.

## DISEASES OF THE LIVER.

These affections are often closely associated with the other troubles of the digestive apparatus which have already been discussed.

Acute congestion of the liver may result from cold, from over-eating, or from the abuse of alcohol. Its symptoms are enlargement of the organ with tenderness on pressure, and a feeling of painful tension on the right side just above the edge of the ribs, often radiating to the right shoulder, slight jaundice, furred tongue, loss of appetite, and scanty, high-colored urine are present, and the whole group of symptoms constitutes the condition commonly designated as "being bilious." It is generally relieved by a small blue pill, followed by a saline purgative, and attention to diet for a few days. If neglected this form may run on to chronic congestion or lay the foundation of inflammation of the liver.

HEPATITIS or inflammation of the liver may arise from taking cold or be the result of injury, or develop out of congestion. It is attended with high fever and severe pain, and is liable to terminate in abscess, which may break internally with a fatal, or externally with a favorable result.

*Treatment.*—The treatment consists of leeching over the affected organ, followed by blisters, and the use of anodynes to relieve the suffering. Mercurials, which were formerly avoided with great care, are probably useful.

ACUTE ATROPHY OF THE LIVER, waxy liver, and fibroid deposit in the liver, are various forms of degeneration for which little can be done by medical treatment, and which are fortunately rare. Not so, however, as far as regards infrequency, with cirrhosis of the liver, called also drunkard's liver and hob-nail liver, because of its origin in the abuse of alcohol, and the peculiar contracted form which it presents. The process which the liver undergoes is a condensation of the substance and destruction of the secreting cells, with thickening of the connective tissue. The whole liver gradually contracts, ceases in great measure to manufacture bile, and becoming an obstruction to the venous circulation, produces ascites or abdominal dropsy, under which the sufferer generally succumbs. The

only cure is for the toper to stop drinking before the destructive change has made any serious progress, and even this may not save him.

JAUNDICE is rather a symptom of disease than a separate malady, and may be due to a suppression of the secretion of bile by the hepatic cells; or, again, by an over-activity of these elements, and a superabundant supply of bile in the system; or, thirdly, by obstruction to the outflow of bile, and reabsorption of its elements into the blood. It consists of a morbid yellowness of the skin, the white of the eye, and other parts; but in bad cases this yellowness may become so intense as to appear olive-green, brown, or even black. The urine is also of a yellow or saffron color, but the discharges from the bowels are pale and devoid of the natural brownish-yellow tint, sometimes having the bluish-white hue of potter's clay. Troublesome itching of the skin, slow pulse, low temperature, debility, and a tendency to hemorrhage from the mucous membranes, are frequent in jaundice. The most important practical point is to determine whether the gall-ducts are obstructed or not. If they are closed, so that the stools contain no bile, the jaundice speedily becomes intense, and the swollen gall-bladder can sometimes be felt below the edge of the ribs. When not obstructed, the reverse is the case. Jaundice which comes on suddenly, is probably due either to a gall-stone or to nervous disturbance. Intense jaundice which has developed very gradually, probably results from pressure outside of the gall-duct, such as would be produced by a tumor or cancer. Intermittent attacks of jaundice point to gall-stones in old people, and to catarrh of the bile-ducts in children. Paroxysmal pain preceding jaundice points to gall-stones; following jaundice, to cancer of the liver. Jaundice with great enlargement of the liver, if the latter is painful and tender on pressure, indicates cancer; if painless, it suggests the waxy or lardaceous condition of the liver. When jaundice accompanies ascites, it is usually due either to cancer or cirrhosis. The danger of life from jaundice, unless it does indicate some fatal disease like cancer or cirrhosis is small; but in its severer forms it is often very obstinate, lasting for weeks or months.

*Treatment.*—The treatment consists of small doses of calomel or blue pill, for a few days, avoiding salivation. The mercurial medicine may be substituted or aided by five grains of extract of taraxicum; podophyllin, and leptandrin, in quarter-grain doses, and bicarbonate of soda in quantities of ten grains. Later on in the attack, five-drop doses of diluted nitro-muriatic acid may be administered with advantage, leaving a few days' interval between the last dose of any mercurial and the acid remedy.

GALL-STONES are hard concretions which form within the gall-bladder, and when they attempt to pass out through the gall-duct often give rise to the most excruciating agony which the human being is capable of suffering. This pain is called hepatic colic, on account of its griping,



tearing character, and may generally be distinguished by its coming on and passing off suddenly; by its frightful intensity; by being deep-seated instead of superficial; by being accompanied with vomiting, and by the pulse being normal, or even slower than natural. It may last from a few moments to several days, and is often so severe that strong men will sometimes writhe, and roll around on the floor, screaming in their agony. It seldom comes on before middle life, and women are much more frequently attacked than men. If a gall-stone remains in the duct for more than twelve hours, it is usually followed by jaundice coming on two or three days later. The affection terminates either by the stone slipping back into the gall-bladder or passing out through the duct into the bowel, in which latter event it may be found in the evacuations during the next week, and should always be searched for. The stone usually varies in size from that of a small shot to an inch or more in diameter, and in color from yellowish-white to dark-brown. If single, it is usually oval or rounded; but if two or more have been formed, the first one is marked by impressions of the others, and thus the prospect of future attacks can be estimated. Notwithstanding the alarming suffering, the danger to life is small, and death rarely eventuates from hepatic colic.

*Treatment.*—The treatment is by thirty-drop laudanum enemas or hypodermic injections of a quarter of a grain of morphia and one-one-hundredth of a grain of atropia, with chloroform or ether by inhalation, if the pain is unendurable. Hot fomentations, or hot baths, sometimes afford partial relief. In order to prevent the recurrence of hepatic colic, small doses of carbonate of soda, alkaline mineral waters, or a mixture of chloroform and turpentine have been highly recommended.

### ASCITES OR DROPSY OF THE ABDOMINAL CAVITY.

Dropsy of the peritoneum, when it occurs alone, is so generally the result of liver disease that it may be appropriately considered here. It is a condition in which the cavity of the peritoneum contains an excess of serous fluid, which is naturally formed in just sufficient quantity to keep the surface of the membrane suitably moist. When it occurs in conjunction with general dropsy, it is usually the result of disease of the kidneys, or of the valves of the heart. The condition is very similar to that which occurs in pleurisy with effusion, as explained in a previous chapter. The prominent symptom of ascites is the distension of the abdomen, which sometimes becomes enormously swollen, and by the pressure upward of the diaphragm gives rise to distressing dyspnœa. The drop-sical effusion can generally be distinguished from accumulation of wind in the bowels, called tympanites, by the dull sound on percussion, and the feeling of fluctuation, which is that of a wave of fluid perceived by the fingers placed on one side of the abdomen, when the other side is

tapped smartly, as the patient lies upon his back. The diagnosis between ascites and ovarian dropsy is sometimes one of great difficulty.

*Treatment.*—The treatment of ascites may be by diuretics, such as teas of juniper berries and cream of tartar, or decoction of broom-corn, if the kidneys are healthy; or by hydragogue cathartics, that is to say, purgatives which produce abundant watery discharges, such as jalap and elaterium, if renal disease exists, as already explained in our article on dropsy. Diaphoretics, such as the hot-vapor or hot-air bath, are often useful. When the amount of fluid is very great, it may be let out by tapping the abdomen, or preferably drawn off by the aspirating apparatus; but the operation is not without danger, and must usually be repeated at shorter and shorter intervals, until the patient is worn out. In ascites from cancer of the liver or intestines, tapping is often worse than useless.

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## CHAPTER XII.

# DISEASES OF THE URINARY SYSTEM.

THE important group of organs which makes up this system comprises the kidneys, two glandular bodies about four inches long, and of the peculiar shape of a kidney-bean, with their outlet pipes communicating with the bladder, and its exit tube the urethra, opening in both sexes in conjunction with the organs of generation. The office of the kidneys in the animal economy is to secrete the urine which passes from each gland down its separate ureter into the bladder, where it may be stored to the amount of half a pint or a pint, and from which it ought, at suitable intervals of from four to six hours, to be evacuated. The ingredients of the urine being waste material, poisonous to the organism if retained in the blood, it will readily be understood why the suppression of the renal secretion, in certain morbid conditions, or its retention in consequence of any obstruction to its outflow, in the narrow ureters or urethra, may give rise to some of the most horribly painful and fatal diseases which mankind is ever called upon to endure. The function of the kidneys is purely an eliminative one, and a full understanding of its performance could only be gained by a study of the intricate structure of the organs, too complex to be considered here. It is sufficient for the present purpose to state, that the blood entering each kidney by its large renal artery is purified by having removed from it the elements of a poisonous sub-

stance, urea, with uric or lithic acid, phosphoric acid, and sulphuric acid, variously combined with potash, soda, lime, magnesia, and probably other refuse matters in smaller amounts. These solid ingredients of the urine are dissolved in the forty or fifty ounces of water which is also during health taken out of the blood by the kidneys, and in this way the urine is manufactured. The purified blood, after giving up these deleterious matters in the renal organs, is returned to the general circulation by the renal veins. In perfect health a man of average size would pass in the forty-eight ounces of urine, which he should daily evacuate from his bladder, an ounce and one-third of urea, nearly an ounce of chlorides, sulphates and phosphates, and from eight to twelve grains of uric acid. If, for any reason, the amount of water filtered out of the blood is less than this, there is danger that some solid constituents of the urine may crystallize within the urine or bladder, and being, perhaps, washed into the ureters in the one case, or into the urethra in the other, block up these outlets and give rise to the horrible agony of nephritic colic, gravel, or stone in the bladder; or, again, even slight inflammation in these small tubes may result in a contraction or stricture, which hinders the passage of the urine, and also causes great suffering to the unfortunate patient. The chief guide to diseases of the kidneys is, necessarily, therefore, a chemical and microscopical examination of the urine, with the sediments which fall from it, in each individual case, and this should never be neglected in any but the most temporary and insignificant derangements of the urinary apparatus.

### ALBUMINURIA OR BRIGHT'S DISEASES.

The most important, because the most frequent, organic diseases of the kidneys are those included under the head of Bright's diseases, so named because Dr. Richard Bright first recognized and made known these affections, less than sixty years ago. There are several acute and chronic disorders of the kidneys usually associated with albumen in the urine, and frequently with dropsy, and with various secondary diseases resulting from deterioration of the blood, but they may be all conveniently grouped in two classes, the acute and the chronic.

Acute Bright's disease, called also acute albuminuria, acute desquamative nephritis, or acute renal dropsy, is a malady in which the kidney becomes greatly enlarged and vascular, with its minute convoluted tubes, in which the urine is primarily manufactured, plugged up with epithelial cells. These epithelial cells in the form of casts of the renal tubules are voided in the urine together with albumen, and sometimes with blood. The obstruction to the outflow of the urine and the interference with the function of the kidney give rise to the most serious general symptoms. There is fever, followed quickly by dropsy, and in severe cases by coma



and death. Acute Bright's disease is a rather common complication of scarlet fever, and is one of the dangers most to be dreaded in that malady. It also occurs in cholera, yellow fever, erysipelas, and diphtheria, and may be produced by alcoholic intemperance, or by exposure to cold and wet, particularly by sitting on a wet or cold object, such as a stone step. The symptoms are first, in many cases, chilliness, followed by fever, some pain in the loins and across the lower part of the spine, scanty high colored and albuminous urine, and in a day or two dropsy, or watery effusion under the skin, beginning beneath the lower eyelids or in the organs of generation, but soon becoming general over the whole body.

*Treatment.*—The treatment, which is successful in a majority of the cases, consists in keeping the patient in bed in a room with a warm, moist and equable temperature, purging gently with those laxatives which cause watery discharges from the bowels, such as small doses of five grains of jalap and thirty grains of cream of tartar, promoting free perspiration by the use of warm baths and hot-air baths, and the application of dry cups, followed by hot fomentations or poultices over the loins. In bad cases, with robust patients, cut-cups or leeches may be used in place of the dry-cups, and acetate or citrate of potash in twenty grain doses, with ten drops of tincture of digitalis or squills, and half a tea-spoonful of sweet spirits of nitre, are often given with benefit. After the first acute stage of congestion in the kidney is relieved by the other remedies, if the dropsy is so excessive as to cause severe pain by distending the skin to a very great extent, punctures with a needle, so as to let the fluid drain off, may be necessary, but these little wounds should be avoided if possible, on account of the danger of erysipelas being thereby set up around the minute openings in the skin.

Chronic Bright's disease may be either a sequel of an acute attack or be slowly developed, without the occurrence of any active symptoms at first. It is connected with further and permanent changes in the structure of the kidney, giving rise to three sub-divisions of the chronic affections, called respectively the granular or contracting, the fatty, and the lardaceous or waxy kidney. Chronic interstitial nephritis, the variety in which the granular or gouty kidney is produced by the morbid processes, comes on usually in persons of middle age, and especially those of gouty habit, or who have lived intemperate lives. The kidney is found after death to be firm, hard, uneven, and sometimes contracted to less than half its natural size. In the form accompanied by fatty kidneys the renal organs have a mottled appearance, and the secreting cells show small drops of fatty or oily degeneration. The lardaceous or waxy form is less common, and appears chiefly associated with similar changes in the liver and spleen in consumptive or syphilitic patients. The symptoms of well defined chronic Bright's disease are albuminous urine, containing renal epithelial cells and tube-casts, more or less dropsical effusion, especially

noticeable about the face and ankles, anæmia, shortness of breath, a peculiar dryness of the skin, dyspepsia headache, and giddiness, together with a tendency to dimness of sight and inflammation of the retina of the eye, uræmia or blood-poisoning from the retention of the urea, which ought to be removed by the kidneys, in the circulating fluid, secondary inflammations, such as pneumonia and pericarditis, and hypertrophy of the heart. Its presence can only be positively ascertained by thorough microscopical examination of the urine, and such examinations repeated from time to time are the best guides as to the necessary treatment. The variety is essentially chronic, running a course of months or years, with a tendency to temporary improvement under treatment, on the one hand, and to sub-acute exacerbations in consequence of unhygienic imprudences, on the other. It almost always proves fatal in the end, however, by uræmia with or without convulsions, by secondary inflammations, or perhaps by general debility. It is estimated that uræmia causes death in about one-third the cases.

*Treatment.*—The treatment of chronic albuminuria is, in the main, hygienic, as indicated on page 50, unless dropsy or symptoms of uræmia require active remedies. Should the former be very troublesome, and diuretics, as suggested when speaking of the acute form, fail to act, as frequently happens, recourse must be had to the hydrogogue cathartics, such as a quarter of a grain of elaterium, already spoken of, with hot-air or vapor baths to promote elimination by the skin, as a partial substitute for the inefficient work of the crippled kidneys. If marked symptoms of uræmia appear, such as headache, drowsiness, involuntary muscular twitchings, sudden and violent vomiting and diarrhœa, recourse to the active cathartics should be had at once, without any preliminary trial of a diuretic, and if uræmic convulsions or coma come on full doses of elaterium or a drop of croton-oil will probably be required immediately to avert death. During the convulsion chloroform may be given by inhalation to restrain the violence, and perhaps shorten the paroxysm.

### HÆMATURIA OR BLOODY URINE.

This condition is an occasional symptom of several diseases, and the name merely implies that the urine is mixed with blood, which may flow from any portion of the urinary apparatus. When bleeding takes place from the kidney it is usually caused by acute Bright's disease, or by stone in the interior of the kidney; when from the ureter, by the passage of a small stone; when from the bladder by cancer, or by stone in the bladder, or occasionally by parasites which make their home in the urinary organs. The presence of blood may be suspected from the red, smoky, or brownish color of the urine, and positively determined by a microscopical examination. If the blood is clotted it generally comes from the bladder, and if



coagulated in long round strings, like earth-worms, it may have been effused in the urethra, from a rupture or ulcer in that membranous tube.

*Treatment.*—The most important remedies in hæmaturia are tincture of chloride of iron, which is especially useful in debilitated patients, in twenty drop doses every three hours, gallic acid in quantities of five grains, and ergot, or two grains of acetate of lead and half a grain of opium every four hours. The effect of the general remedies may be aided by the injection of a weak solution of alum in cold water, thrown into the bladder by means of catheter if the case is urgent. Where a large mass of coagulated blood is formed in the bladder it may sometimes be gotten rid of by the injection of a solution of pepsin, which, if the ingenious plan succeeds, dissolves the clot of blood.

### SUPPRESSION OF THE URINE.

This is an affection in which the work of the kidneys in secreting the urine is very defective or altogether abolished. There may be some pain in the back, or irritability of the bladder, the patient becomes anxious and restless, then dull and drowsy, and finally after an interval of from three to eight days usually dies comatose. In other instances there is nausea and vomiting, hiccough, and the whole body exhales a urinous odor. Where the suppression is less complete, and depends upon some obstruction to its outflow in the ureters, bladder, or urethra, the mind remains clear for a long time, perhaps, and the unfortunate patient is fully conscious of the intense local suffering and general distress produced. The time during which the urine may be suppressed and yet the patient recover varies considerably. In hysteria, cases where no urine has been passed for ten days are reported, but such instances are not free from suspicion of possible deception on the part of the patient. Children when teething will sometimes for days together void only a few drops of urine at once, and that at several hours interval. The urine passed at such times is extremely high colored, stains the linen, and is passed with great pain, the child crying bitterly, as it scalds the sensitive surface over which it flows. This disease probably arises, at least in some instances, from over-congestion of the kidney.

*Treatment.*—The treatment recommended is to place the patient in a warm bath, and give a saline diuretic, such as a tea-spoonful of cream of tartar, or twenty grains of acetate of potash dissolved in half a pint of water, combined with a moderate laxative. The sweet spirits of nitre, in half tea-spoonful doses, is also frequently useful. Digitalis leaves made into a poultice, or the tincture of digitalis added to a flax-seed poultice, have often proved beneficial, and the digitalis may also be used internally with advantage in the form of a tea-spoonful of infusion every four hours.



## NEPHRITIC COLIC.

Since the ureters commence inside the kidneys as funnel-shaped tubes, it is obvious that any solid substance capable of entering the upper part and yet a little too large to pass the lower portion, will stick fast, and can only progress as the pressure of the constantly secreted urine behind it, drives it along with sufficient force to dilate the pipe and allow it to move onward. This process of dilatation is horribly painful, and with that of passing a gall-stone, and of certain forms of neuralgia, makes up the worst physical suffering of humanity since the Spanish Inquisition was abolished. The little stones which cause such agony in this way are generally composed of uric acid, or less commonly of oxalate of lime, deposited from the urine inside the kidneys, and washed down from the seat of their formation by the outflow of that fluid. It is not positively determined whether they crystallize out of the urine because they are produced in too large quantity in the system, or because a deficient amount of water to hold them in solution is filtered out of the blood; but in either case, increasing the bulk of the renal secretion by drinking a larger quantity of water daily, is a most rational method for diminishing the tendency to their production. The first symptom of an attack of renal or nephritic colic is usually pain in the region of the loin on the affected side. This rapidly increases in severity until it becomes excruciating, and radiates downward toward the groin, the testicle on that side being drawn up, a symptom constituting in males—who are chiefly the subjects of this malady—an important diagnostic sign. With the pain, nausea and vomiting are apt to occur, and the body is covered with a cold sweat. In severe cases, where the stone is no doubt relatively large, the patient often writhes about upon the bed or floor, groaning in agony. Gradually the distress seems to move on down, and at the end of from an hour to a day or so—which seems like an eternity to the patient—he is suddenly relieved as the calculus slips into the bladder. When this grateful relief is not experienced, and there is only some mitigation of the pain, with continued suppression of the urine, the stone has probably become firmly wedged into the ureter, and distension of the kidney, and ureter behind it, with very dangerous results, are to be feared. An onset of renal colic may in some fortunate instances be much milder than this, only lasting a few minutes, and not being marked by such intense suffering, the difference being no doubt due to the smaller size of the concretion. The attacks may be single, but are more apt to recur at irregular intervals of weeks, months, or years.

*Treatment.*—The treatment of nephritic colic is to relieve the pain, if only moderately severe, by hypodermic injections of morphia and atropia, or laudanum enemas, as advised in the article upon gall-stones; but if the suffering is intense, by the inhalation of ether or chloroform. In

order to mitigate the pain sufficiently by these anæsthetics, it is not usually needful to administer them to complete unconsciousness. A few whiffs will lull the distress so as to make it endurable for the time, and as this blessed influence passes off, it can be renewed by a repetition of the inhalation. Persons whose hearts and lungs are healthy, can thus be kept in comparative comfort with comparative safety, for several hours, or until the passage of the stone out of the lower end of the ureter into the bladder renders the anæsthetic no longer necessary. It is probable that both morphia and ether tend, besides, to hasten the exit of the stone by relaxing the spasm, which no doubt is caused by the irritation of the angular corners of the cruel little calculus, as it makes its way through the slender and sensitive tube of the ureter. After the passage of a stone of this kind into the bladder, it usually is voided with the urine, in the course of the next day or two, and in order to make sure that the enemy has been completely gotten rid of, it is best to carefully examine all the urine which comes away in the next few days after an attack. The character of the stone, when found, will afford some information as to the best mode of treatment to be adopted for the purpose of avoiding the formation of others of like structure. Besides, a renal calculus may occasionally be retained, and constitute the nucleus of a larger stone in the bladder. Hence, it is advisable, for a week subsequent to the colic, to pass water at least twice daily whilst on the elbows and knees, with the hips raised higher than the shoulders, in order that the concretion may be washed out, instead of lurking, as it may do otherwise, in the little depression below the inner opening of the urethra, which constitutes the lowest point, whilst the body is in an erect posture. Occasionally the calculus formed in the kidney is too large to enter the ureter, and it then remains in the renal organ, giving rise to much dull aching pain, and sometimes, especially after riding on horseback or in a springless wagon, to a discharge of bloody urine. Occasionally, too from the irritation thus set up, or from other causes, abscesses are formed in the kidney, or the whole organ may be converted into one large abscess; or, again, pus may develop in the connective tissue around it, constituting what is called perinephritic abscess.

Hydronephrosis is a dilatation of the upper end of the ureter inside the kidney, or of the glandular structure of the renal organ, into one or more cysts by retained secretion of urine, which is prevented from escaping, as, for example, by an impacted stone in the ureter.

### DISEASES OF THE URINARY BLADDER.

The bladder is a membranous pouch or bag for temporarily holding the urine, and is made of three coats or layers. The outer of these is a simple skin derived from the peritoneum. The middle coat is composed



of involuntary muscular fibres, which entirely surround the organ, and by their contraction empty it; and a mucous membrane forms the inner lining.

Cystitis, called also vesical catarrh, and catarrh of the bladder, is a condition of extreme irritation or inflammation of the mucous membrane lining the bladder. In the acute form, its symptoms are pain over the region of the bladder; scalding on passing water, which the patient is compelled to do very frequently; after a day or two, the discharge, with the urine, of mucus; and later, of muco-pus. It may be produced by taking cold; by the irritation of a stone; by the poison of gonorrhœa; or may occur in the course of paralysis, especially paraplegia.

*Treatment.*—Treatment in the acute form comprises the warm bath, suppositories of a grain of opium and one-sixth of a grain of belladonna, flax-seed tea, and the use of saline purgatives. In the chronic variety, teas or fluid extract of buchu, uva-ursi, and pareira brava, are often used, and in obstinate cases, five-drop doses of diluted nitro-muriatic acid, or salicin in quantities of five-grains thrice daily, may prove useful.

Calculus or stone in the bladder is a severely painful disease, and, unfortunately, quite common in some parts of the country. It is supposed by some authorities to be in part due to the lime and magnesia contained in the hard water used for drinking in certain districts. It is much more common in men than in women. The suffering is sometimes very severe, and is nearly always felt more or less both night and day. There is a continual and distressing sensation, as if there were retained secretion in the bladder, and more or less sub-acute inflammation is usually set up. The medical treatment is only palliative, and similar to that recommended in cystitis. The surgical operations of opening the bladder and taking out the stone, called lithotomy, and of lithotritry or crushing the stone, if of suitable size and texture, within the bladder, by means of a very ingenious instrument, afford, when successful, as they are in a large proportion of cases, a complete cure. After getting rid of a stone, something can be done by the management of the diet, and above all by the avoidance of impure drinking-water, toward escaping the further formation of these dangerous and painful concretions in the bladder. It is important, however, to determine the nature of the calculus removed, and this can only be decided with certainty by a chemical and microscopical examination.

The wall of the bladder may be the seat of cancer or a so-called villous tumor, and of other morbid growths, which, however, are seldom met with. They are usually beyond the power of either medicine or surgery, except so far as the pain to which they give rise can be palliated by opiates.

Paralysis, irritability, and spasm of the muscular coat of the bladder, are not infrequent. When the muscular layer is irritable the urine has



to be voided too frequently, producing incontinence of urine. This is sometimes a very troublesome affection in young children, often, however, in great part a bad habit, which is cured as soon as it has been broken up, let us say, by an anodyne suppository of one-twentieth of a grain of extract of belladonna and one-quarter of a grain of opium, to a child six years old, for four or five nights in succession.

Among the diseases of the prostate gland the most important are chronic enlargement and calculus. This gland is situated just in front of the neck of the bladder, and encircles its outlet, the urethra. Hence its enlargement is apt to interfere with the outflow of the urine from the bladder as soon as it increases beyond a certain point. The difficulty thus caused in passing water is especially apt to affect elderly men, and would be very serious had not surgical science supplied a peculiarly formed instrument, called the prostatic catheter, by which the impediment can usually be overcome temporarily.

The urethra, which constitutes the final channel through which the renal secretion flows in making its exit from the body, is likewise subject to inflammation, and to obstruction from calculus, and, most important, to narrowing in consequence of inflammatory action. This contraction of the canal is called, as most people aware, stricture of the urethra, and notwithstanding the numerous tales of accident producing this trouble, which are poured into the credulous ears of physicians, its true cause is, at least nine times out of ten, gonorrhœa, which will therefore be considered in this connection.

### GONORRHŒA.

Gonorrhœa, or, as it is vulgarly called, the clap, is a specific inflammation of the urethra, the result of contagion and very seldom innocently acquired. In the female it affects chiefly the vagina, and is much less serious or painful than in the male sex. The first symptom in the male is a slight uneasy sensation or tickling at the mouth of the urethra, which is generally felt between the second and seventh day after exposure to infection. On examination the organ is found slightly reddened, and the natural discharge of mucus a little increased, and more viscid than usual. These signs of irritation soon pass into those of inflammation, in which the redness, heat, pain, and swelling, characterizing that process, are all experienced in an exaggerated form. The discharge becomes thick, yellow or greenish, and the pain on passing water, which must be done frequently, is very severe. Swelling and inflammation of the glands in the groins, commonly called a bubo, is common, but the irritation seldom goes so far as to result in suppuration and abscess. Orchitis or inflammation of the testicle is more frequently observed. The disease is apt to last under the best treatment for a period of from four to six weeks, and if neglected or badly managed may be months before it is cured.

*Treatment.*—The most important part of the treatment is rest in bed, but as this can seldom be secured the inflamed parts should be supported by a suitable suspensory bandage. At first the treatment must be that of inflammation elsewhere, that is by saline purgatives, such as a table-spoonful of Epsom salts, low diet, and half tea-spoonful doses of sweet spirits of nitre or ten grains of Dover's powder to promote perspiration. Wrapping the affected parts in cloths soaked in a mixture of four ounces of lead-water and two grains of acetate of morphia, and covered with oiled-silk is useful, and the injection of dilute solutions of the same medicines, made by mixing an ounce of this liquid with three ounces of water may be cautiously tried. The scalding on voiding urine may be mitigated by drinking freely of flaxseed tea containing two drams of acetate or bicarbonate of potash to the pint, and a belladonna and opium suppository at night, repeated in two hours if needful, will generally prevent much trouble from chordee. The diet should be rice, bread with very little butter, milk, and, if necessary to keep up the strength, soft-boiled eggs. Meat, alcoholic and malt liquors, acids and condiments, are particularly objectionable. After the first violence of the inflammation begins to subside the injections may be made stronger gradually, allowing them to be of sufficient activity to produce a little smarting, lasting not longer than five minutes, each time they are used. They should be employed directly after each passage of urine, provided that does not occur oftener than once in two hours. At this period the administration of balsam of copaiva is usually commenced, and a good article of oil of sandal-wood appears to be even more efficient in checking the remaining discharge, two capsules of either remedy being taken four times daily. In the course of another week injections of acetate of zinc, sulphate of copper or nitrate of silver, one or two grains to the ounce of water, may come into service with benefit, but great care must still be exercised in regard to errors in diet, a single glass of malt liquor being frequently sufficient to bring on a relapse. If neglected or badly treated the malady may run into the chronic form, which is called gleet, and often proves exceedingly rebellious to treatment. Ten drops each of tincture of chloride of iron with tincture of cantharides thrice daily, often, however, succeed in bringing about a favorable change, and the introduction of a bougie smeared with belladonna ointment three times a week is apt to contribute to the cure.

Stricture of the urethra constitutes the great danger of gonorrhœa, which would otherwise, though painful and disgraceful, be of comparatively little moment from a medical point of view. If, however, a youthful indiscretion of this kind results in a dense and narrow stricture, as is frequently the case, it not only makes the after years of life utterly miserable, but often hastens on a premature death. The contraction of the urethral canal, which so often results from a severe or prolonged attack of gonor-



rhœa, may go on increasing for some months before its presence is observed. Usually the attention is attracted by the circumstance that the desire to urinate becomes more frequent, and the force of the stream diminishes, so that the renal secretion dribbles away in drops, or runs off in a very fine stream not larger than a knitting-needle. There is more or less pain in passing water, and a good deal of straining is required to accomplish the operation, which begins to be dreaded from day to day, and even from hour to hour. The treatment of stricture is purely surgical, as, being a mechanical obstruction, medicines can accomplish nothing for its relief. The usual method is by gradual dilatation, using first a small steel rod bent at the suitable curve and highly polished. This is to be warmed and thoroughly oiled, and then carefully passed into the bladder through the urethra, scarcely any force being employed. The great danger is that some of the inflamed and softened tissues in the neighborhood of the obstruction may give way, and what is called a false passage being formed, the condition of the patient is rendered far worse than before. The largest size that can be used successfully having been introduced, it is allowed to remain a few minutes and then an instrument of a little greater diameter is employed, and so on until the urethra, not without considerable suffering, is stretched to the original magnitude. In most instances, however, this dilating process must be kept up for months, the patient himself learning how to use the proper instrument, and introducing it at longer and longer intervals for a year or two until completely cured. Various other methods for relieving the obstruction of stricture have been devised, such as external incision, cauterization, and so forth.

In the emergency of an attack of retention of urine in a man who is the subject of stricture coming on whilst far from medical assistance, the first thing to do is to get into a warm bath, since this will often procure sufficient relaxation of the spasm, which always makes up part of the narrowing of an irritated stricture, to allow a little urine to dribble away, perhaps whilst bathing, and so relieve the distress of the patient. If this fails a laudanum and belladonna injection or suppository, or a full dose of twenty drops of laudanum, will frequently have the desired relaxing effect. Care should be taken to drink as little fluid as possible, so as to diminish the amount of the renal secretion to a minimum, until the avenue for its escape is again partially unclosed. If a catheter can be procured, the patient should try to pass it himself, choosing the time when he is still partly under the influence of the opium, which dulls the excessive sensibility of the urethra. In the absence of a catheter it has been most ingeniously suggested by Dr. Levis, of Philadelphia, to use a piece of bell-wire, doubled and bent to the right curve, along the sides of which, if safely introduced, enough urine might flow to relieve the over-distended bladder. Should all other means fail, in order to prevent the bursting of the bladder, which may occur any time after thirty-six



hours of complete retention, and lead to almost certain death in extreme misery, the bladder should be punctured through the rectum. This operation ought to be done with a curved trocar and canula, but may be performed with a curved or bent knife, which should be passed up into the rectum guarded by the finger, and then pushed forward into the bladder, at a point about an inch and a half from the margin of the anus, where the rounded tumor, composed of the distended bladder, can be felt in front of the tip of the finger, and perhaps only one-eighth of an inch distant. An immediate gush of urine, followed by intense relief from the agony of distension, would show that the operation had been successful, but the patient will be left in a wretched condition, the urine constantly dribbling away through the recto-vesical fistula thus produced. Though this may be cured by a subsequent surgical procedure, the risk and the evils attendant upon puncturing the bladder in this way are so great that it should only be resorted to in extreme cases. At the best it is an alternative which is itself a grievous misfortune, and the danger of being driven to look upon it as an inestimable boon, should be a constant check upon the otherwise unbridled indiscretions of youth.

### SYPHILIS OR VENEREAL DISEASE.

This other form of punishment for immorality, even more far-reaching in its effects, since it often affects the unborn children of the offender, may be conveniently discussed in the present chapter. It is a disease the result of a specific poison produced solely by direct implantation of the contagious material, usually the purulent discharge from a venereal sore in a previously diseased person. About a month after it is in any mode implanted in the human system it appears to begin a development throughout the whole organism, and penetrating to every part of the body, affects especially the skin, glands, and throat, in the form of secondary symptoms, and still later the cartilages and bones as tertiary manifestations, until finally if unchecked it often proves fatal, after intense and prolonged suffering.

The first symptom of this horrible disease is usually a primary sore or chancre, which appears as a small pimple or blister upon some part of the organs of generation any time within two or three weeks after the infection is received. The great distinction between the syphilitic ulcer, or true chancre, and the chancreoid, or non-syphilitic sore, is that the former has a hardened base, but the most eminent surgeons admit that neither this nor any other criterion is infallible. The infecting pimple may dry up without ulcerating, but more commonly a cup-shaped sore from an eighth to three-eighths of an inch in diameter, and with raised edges, is formed, and unless modified by treatment lasts for a month or six weeks, when it heals up, leaving a hardened lump of a dark red,

coppery, or bronze color, which is often several months in completely disappearing. The glands in the groins during the ulcerating stage of the primary chancre become swollen, hard, and slightly painful, but seldom suppurate. After some weeks the other lymphatic glands partake of this enlargement, and gradually those in the armpit, in the neck, and behind the ear, give evidence of the general infection.

The chaneroid, soft-chancre or non-syphilitic sore, generally develops in a few days from the date of infection, first as a minute vesicle, then a pustule, and later as an ulcer, round or oval in shape, with clean-cut edges, and without any hardening of the base. The floor of the ulcer is generally covered with a thick yellowish matter, which is virulent and contagious in the highest degree. The glands in the groins are often not swollen, but if affected are much more apt to suppurate, constituting a bubo, the discharge from which is also intensely contagious. It is therefore far more troublesome than the primary syphilitic sore, and yet infinitely to be preferred to the latter on account of the absence of any constitutional infection.

After a true or hard chancre has developed, and no matter whether it has healed promptly or is still open, there appears in about four weeks, on an average, from the first infection the first of the train of general or constitutional symptoms. These consist of the tumefaction of the lymphatic glands, followed after a few weeks more by fever, headache, rheumatic pains, and soreness of the throat. About the tenth week after the dearly bought pleasure its unfortunate purchaser usually finds a crop of eruption appearing upon his skin, sometimes slight and easily concealed, but oftener well defined and in a tell-tale abundance, which instantly reveals his guilty secret. This eruption may be of pimples, pustules, or scales, the former being the most common and having a new copper-colored red or brownish-red tint, which, when well marked, is to the experienced eye very characteristic. It is apt to be especially abundant round the sides of the nose and angles of the mouth and eyes, the roots of the hair on the forehead and back of the neck, the centre of the breast, the inner side of the limbs, and around the armpits and groins. An important diagnostic mark of the scaly, syphilitic eruption is its appearance on the palms of the hands and the soles of the feet. These manifestations are also particularly liable to appear as pustules among the hair of the scalp. In some cases the whole body is thickly covered. After persisting for periods varying from two or three weeks to as many months, these spots usually fade, leaving behind them brownish stains which are very persistent, but ultimately may give place to pale scars, somewhat like the pitting of small-pox in a very mild form. In a minority of instances the patient escapes any well defined symptoms, but suffers instead from one of the following manifestations of secondary syphilis, which often accompany the eruptions also: Alopecia or falling of the hair, which in bad cases



may include not only that of the head, but also the eyelashes and eyebrows; flat whitish sores in the mouth and anus, called mucous patches, the discharge from which in the former situation may easily convey, by kissing, the whole vile disease to a perfectly innocent person; inflammation of the iris injuring or even destroying the sight; and local diseases of the generative organs.

The late or tertiary symptoms of venereal disease are disease of the cartilages and small bones of the nose and throat, producing the shocking disfigurement of the countenance sometimes seen, especially among sailors; disease of the bones of the skull leading to persistent and excruciating headache, and sometimes actually perforating the cranium; disease of the tibia or large bone of the leg between the knee and ankle; disease of the nails which may entirely ulcerate out; disease of arteries which, of course, is most apt to prove fatal; and peculiar new growths called gummy tumors, which may appear in all parts of the system. It must not be supposed that this horrible picture is produced in the portrait of every syphilitic patient. In many fortunate instances the disease appears to be naturally of a mild type or to yield readily to the treatment employed, and in many others long continued perseverance in the use of the proper remedies seems, after repeated relapses, to finally root out the shameful malady from the system. Yet it is a melancholy fact that in some cases, whether from the primary virulence of the poison, or from neglect of suitable treatment at a sufficiently early stage, or perhaps from some constitutional taint or predisposition, possibly from a combination of all these causes, medicine appears powerless to check the ravages of this vile disorder. Evidence of the truth of this statement may, unhappily, be found in the hospitals and almshouses of any large city, and it has often occurred to the writer that if every youth about entering manhood could be conducted through the venereal wards of one of these institutions, it would do more for the cause of morality, which true philanthropists have so earnestly at heart, than all the eloquent sermons which have ever been preached against debauchery and vice.

Congenital syphilis generally shows itself between the third and sixth week after birth, by cutaneous eruptions, similar to those seen in the secondary period of acquired syphilis, and of most frequent occurrence upon the buttocks, abdomen, palms, and soles. Congestion and sub-acute inflammation of the mucous membrane of the nose, with increased discharge, vulgarly called the snuffles, also appear, and the infant has usually a peculiarly shriveled, weazened aspect, like that of a prematurely old man. Mucous patches from about the baby's mouth, may infect the mother or nurse, and keratitis or inflammation of the cornea of the eye is lamentably common. Early and active administration of mercury is very important, lest the syphilitic cachexia prove fatal.

*Treatment.*—The treatment of the primary sore or chancre is much



disputed. Cauterization with nitric or chromic acid, or the acid nitrate of mercury, and subsequent dressing with black-wash—a mixture of a dram of calomel and a pint of lime-water—is much employed; but the application of iodoform is highly recommended. Complete excision of the sore, with its hardened base, in the hope of preventing secondary symptoms, has been tried without success, even when performed early. If the enlarged glands in the groins give rise to much discomfort, they should be painted over with the tincture of iodine.

The prompt destruction of the chancreoid ulcer by caustic, and the dressing with black-wash or yellow-wash, is advisable, and hope may be entertained of thus putting an end to the whole malady. If the glands in the groins go on to suppuration, however, very serious trouble may be anticipated before a cure is effected.

The treatment of the secondary symptoms is by the use of mercury, which, although decried by some physicians, is considered by our best authorities as the only effectual remedy for syphilis. It may be administered by inunction of mercurial ointment, by fumigation, or in the form of half a grain of calomel, or blue pill, or one-third of a grain of the iodide of mercury thrice daily, and should be kept up at intervals for a year or two after an apparent cure has been effected. To obtain its beneficial effects, which are often very marked and satisfactory, it is not necessary to induce severe salivation, which, probably, in former times, often aggravated the ultimate effects of the syphilitic poison.

In the tertiary stage, iodine and iodide of potassium, in the form of the compound iodine solution, or the iodide occasionally in very large doses of fifteen or twenty grains, thrice daily, are the great remedies; but they may sometimes be associated with mercurials to much advantage. In a majority of instances, the development of well-marked tertiary symptoms may be prevented by judicious treatment in the second stage of the complaint, and even when a slight tendency to disease of the bones and cartilages is displayed, a combination of the iodides with mercury will often avert disastrous consequences.

Throughout the whole management of the case the administration of tonics, such as iron, quinine, and strychnia, is very important, and strict attention to hygiene by promoting the best general health, is an almost indispensable condition to securing a favorable result.

Professor Alfred Fournier, in a late instructive work on syphilis and marriage, formulates some valuable conclusions in regard to the very difficult problem, from a hygienic point of view, whether a syphilitic person ought to marry or not. He asserts that a man who enters upon marriage, with syphilitic antecedents, may become dangerous: first, to his wife; second, to his children; third, to the interests of his family. In the first place the wife is apt to be infected directly by contact with the pus of secondary lesions; and Dr. F. says: "I know from long experience

that it is rare to see a young wife live with a syphilitic man, or conversely, without the health of the former being affected by the diseased one." It was this which caused a witty French observer to say: "The pox is partaken of by a married couple equally, just like the daily bread." Secondly, a man may convey syphilis to his wife by causing conception, as when a young girl, pure and healthy, is married to a man whose venereal disease has not been thoroughly cured. The physician calls a few months later and finds her diseased with, for example, distinct secondary symptoms, such as cutaneous syphilides, mucous patches in the mouth, scabs on the scalp, swelling of the glands in the neck, headache, vague pains, lassitude, febrile attacks, loss of hair, and so forth—all this without a trace of chancre, and even without that faithful companion of a chancre, a bubo, which M. Ricord calls so aptly the posthumous witness of a chancre. In these lamentable instances, the wife-mother, infected without having had any primary symptoms, and whose husband has long been freed from all external indications, is diseased, not from that husband, except indirectly, but from her child still within her womb. As respects the danger to children: Although offspring may be begotten by a syphilitic father, who enjoys good health, yet the hereditary influence of paternal syphilis is very far from being as innocent, minute, or negative as has been maintained. This inherited tendency may be developed in the three following modes: Either that, which is an exceptional case, by the transmission of syphilis to the fœtus; or that, which is sufficiently common, by the death of the child; or lastly, by the inherent degeneration of the germ, which ultimately reveals itself under a great variety of morbid conditions. But the worst form of danger to the family of a syphilitic father, is, that communicating the disease to the wife, the paternal and maternal influences will act upon the same side, and most disastrously conspire in unison against the fruit of any pregnancies which may result. In such sad cases we can predict that, with a few rare exceptions, either, first, the child will die before birth; or, second, it will be born with syphilis, and with all the possible and serious consequences of infantile syphilis, which in many cases are equivalent to death itself; or finally, third, it may be born without syphilis, but with uncertain health, with a weak nature and a feeble constitution, which will probably expose it to a rapid death; with menacing morbid tendencies; with a predisposition to certain organic diseases—in a word, to a relatively speedy decay; this terrible fate being visited again and again upon successive innocent babes.

Dr. Fournier gives, in this connection, the following instructive history of a patient he treated for a long time in the Lourcine Hospital in Paris. "This woman, tall, vigorous, and healthy, was married at nineteen years of age; she commenced by having three superb children, of whom two are still alive, and by her own account in excellent health; the third



appears to have succumbed to some incidental acute illness. Subsequent to her third confinement this woman contracted syphilis from her husband, who himself had recently acquired it. Since then, she has become pregnant seven times, with the following results:

First pregnancy after syphilis.—Miscarriage at five months.

Second ditto.—Premature birth at seven and a half months; child miserable and stunted, dying on the fifteenth day.

Third do.—Confinement nearly at the full time; child born dead.

Fourth do.—Premature confinement; child born dead.

Fifth do.—Premature confinement; child born dead.

Sixth do.—Miscarriage at three months and a half.

Seventh do.—Miscarriage at six weeks.

*Resumé.*—Ten pregnancies, of which three, prior to syphilis, resulted in proper, full-term children, perfectly well formed; and seven, subsequent to syphilis, of which four were premature births, and three miscarriages; only one of these seven infants being born alive, and that one surviving but a few days.

The five indispensable conditions of admissibility to marriage, after syphilis, are, according to Dr. Fournier:

1. Absence of actual specific symptoms; for, if the obvious symptoms are of a nature to be transmitted, the objection to marriage is as formal and absolute as possible; and should any one existing not be of a contagious character, it does not the less reveal a permanent diathesis with all its horrible consequences.

2. Advanced age of the diathesis; because the more recent the syphilis of the husband, the greater and more numerous are the dangers that he introduces into the marriage.

3. A period of immunity sufficiently long since the last specific manifestations; the minimum interval being eighteen months or two years.

4. Non-menacing character of the diathesis. This condition is to be insisted on, because, undoubtedly, venereal disease is sometimes of a benignant and sometimes of a malignant type. In the former, the patient has only a small number of breakings out. The symptoms which accompany these are superficial and mild; and the diathesis is rapidly and easily amenable to therapeutic agents. Still, it is to be remembered that the initial benignity of syphilis does not constitute a pledge of security for marriage, if it is not joined to other guarantees, notably to sufficient treatment; also, that a certain variety of mild syphilis, on account of the persistence of ulcerations about the mouth, throat, and so forth, is a bad syphilis for marriage.

5. Sufficient specific treatment; this is the condition *par excellence*, and, according to the author, in no case should the duration of anti-syphilitic treatment be less than three or four years, whatever may be the form of the disease, and however mild it may have been originally; even then it



is prudent for the patient to submit himself from time to time, every two or three years, for example, to a new course of iodide, so as to keep the diathesis in check and hold the ground already won.

Finally, when syphilis appears after marriage, as the result of exposure in some adventure, or rather *misadventure*, just before the nuptials, or at some subsequent time, the precautions are: Prompt cauterization with the acid nitrate of mercury of primary sores and all secondary lesions of a superficial erosive, or of a papular erosive character; the latter two classes especially, because the very mild lesions of the secondary period are the most dangerous as regards contagion.

This great question of the prevention of venereal diseases is to-day one of the most intensely living issues engaging the attention of American sanitarians.

At the New Orleans meeting of the Public Health Association, Dr. Gihon of the Navy, as chairman of a committee on the subject, presented a valuable report, in which he remarked: "Every one instinctively shrinks from the touch of the sufferer with small-pox, but how few realize that a syphilitic is a leper also to be most scrupulously shunned? How few mothers are aware of the danger, to themselves and their children, from nurses and housemaids drawn from a part of the population in which every fifteenth person is thus diseased? How few parents suspect the peril to their daughter from her accepted lover's kiss, since he may be that one in about every five young men among the better classes who has a venereal disease, which there is one chance in two is syphilis." These are not mere speculations, for Professor Gross reports that he has seen many cases communicated by kissing; and he tells of fifteen women, nine children, and ten men diseased by a single midwife, who had a chancre on her finger, contracted in the exercise of her profession, and who had thus carried the disease from house to house.

Dr. J. Marion Sims says: "I have seen a cook and a chambermaid with syphilitic ulcers on their fingers; I have seen nurses infected by the children they had nursed, who were born of syphilitic parents, in turn infecting sucking babes, born of healthy parents; and I have known a drunken vagabond husband to contract syphilis and communicate it to his wife, who in turn gave it unwittingly to her four children, simply by using the same towels and washbowl."

One of this very committee adds the case of an estimable and venerable lady, who lost her eyesight that year, from a venereal affection arising from using a towel in her son's room, carelessly left by him upon the rack; and of another, the wife of a clergyman, who the preceding summer sought relief at a Virginia spring for a horrible affection contracted in domestic contact with her servant.

The present Surgeon-General of the Navy saw a number of cases of chancre of the lips among the smokers of one set of cheroots, of which

the wrappers had been moistened by the saliva of a Manilla cigar girl; and at Beyroot he learned that it was not unusual for syphilis to be contracted by using a *narghileh* that had been pressed by the lips of a diseased smoker. How many people would venture to eat Smyrna figs if they had seen the the top layer of the choicest box pressed flat with the saliva-wetted thumb of the packer, who, there was one chance in ten, was a syphilitic?

A certain lady was terribly alarmed when told by her husband, a physician, that she had invited to her table a young man who, in the course of a physical examination that morning, he had found to have his mouth and tongue covered with mucous patches; and that her daughter was dancing in a public ball room with another whose body was repulsive with syphilitic eczema.

An editorial in one of our Philadelphia medical journals not long since stated: "It has happened to the writer to be recently called to see a man of most respectable surroundings, who bore an unmistakable venereal sore upon his lip, and subsequently manifested all the features of secondary syphilis. It was said that this sore had followed a trifling surgical operation upon the part affected for the removal of a slight deformity, during which the instruments or the hands of the surgeon had inoculated him with syphilis.

This energetic committee urged that it should be promulgated everywhere throughout the community, that so long as syphilitics are allowed to go unrestrained the spotless woman and the innocent child share the danger of this horrible contamination with the libertine and the courtesan. Let it be known by everyone they exclaim, that this fearful pest may be communicated,

By the blankets of the sleeping car, the sheets, towels, and napkins of the steamship, hotel, and restaurant.

By the hired bathing dresses at a seaside resort, and the costumes rented for the fancy ball.

By the chipped edges of cups and plates, as seen at any hotel or eating house, and by the half-cleansed knives, forks, and spoons of the same.

By public drinking vessels in a railway car or station, as well as the public urinal or water-closet.

By the barbers utensils, the comb and brush in the guest chamber, the hatter's measure, or the borrowed hat.

By the surgeon's and dentist's instruments, or the vaccinator's lancet.

By the broom or dust-brush handled by a parlor maid, or by the spoon or cup touched by the mouth of a cook or nurse.

By whistles and other toys sold to children in the streets by vendors with poisoned lips or fingers.

By playing or visiting cards which have been used, and especially by car tickets and paper money circulating in a city like Philadelphia, where 50,000 syphilitics are at large.

By the grasp of a friend's hand or the kiss of a betrothed lover, by the son to his mother and sister, the husband to his wife and unborn child, and by the latter to its mother.

Were venereal disease restricted to those who seek illicit sexual gratification it might be well to let the guilty suffer and die; but when their sin is sure to leave upon them an ineradicable taint, and be transmitted to their helpless offspring, should they have children, when, worse than all, the syphilitic leaves his stain upon whatever he touches to foul the chance passer, man, woman, or child, no matter how innocent, as fearfully as if they had visited the vilest lupanar, it becomes the duty of the Public Health Association—the most important of all its duties—to devise some plan for their protection.

They therefore proposed the following excellent and very moderate resolution, which was finally adopted after much opposition:

Resolved that the American Public Health Association earnestly recommends the municipal and State boards of health to urge upon the legislative bodies of this country the enactment of a law constituting it a criminal offence to knowingly communicate, or to be instrumental in communicating, by any direct or indirect means, a contagious disease, such as small-pox, scarlet fever, or venereal disease, and giving to said boards of health, and to the State and municipal health officials under their control, the same power in the detection, prevention, suppression, and gratuitous treatment of venereal affections which they now possess in the case of small-pox and other contagious diseases.

And in the interests of decency and morality, as well as for the sake of the suffering wives and innocent born and unborn children of our country, it is hoped that this recommendation will not much longer pass unheeded.

### SPERMATORRHŒA.

As an appendix to the unsavory subjects discussed in this chapter a few remarks upon spermatorrhœa and its usual cause are appropriate here. It would be impossible to estimate, with any approach to accuracy, the vast amount of anxiety and mental suffering needlessly endured in our community in regard to this disease. The lying advertisements of unprincipled charlatans are less openly displayed than formerly, and yet means are found with satanic ingenuity to reach their victims, and cruelly arouse, from mere mercenary motives, their liveliest apprehensions. That the disease called spermatorrhœa exists, and in rare cases does result in the utter wreck of mind and body, which is painted by these designing quacks in such sombre colors, cannot be denied, but that nineteen out of every twenty young men who have become alarmed by the occasional or even frequent occurrence during sleep of what they have learned to con-



trol whilst awake, have no real ground for their agonizing fears is equally indisputable.

The usual cause of spermatorrhœa, of course, cannot be freely discussed in a popular work like this, and yet enough may be expressed in veiled language, the meaning of which will be only or chiefly comprehended by those who need the lessons inculcated, to accomplish, it is hoped, much good. Many young persons of both sexes, after being made aware of the danger in which they were becoming involved through evil examples, perhaps, of school associates, have earnestly tried to escape the thralldom of bad habits. Some of those who have succeeded, by the exercise of a resolution and strength of will, for which they deserve great credit, have overcome their enemy, but are yet haunted with the fear that they have been irreparably injured in the struggle. This fear is entirely unfounded, as time will infallibly prove. A second and larger class are still discouraged by frequently recurring evidence that they are not in a natural and healthy condition, and some may even be so disheartened as to feel almost hopeless. For such plenty of exercise in the open air, good nutritious food, chiefly vegetable, occupation of the mind in some study or suitable recreation, and the medical treatment of full doses of bromide of potassium every evening for a week, with or without a one-grain opium suppository at bedtime, can with a continued exercise of the will power during the waking hours speedily accomplish a cure. To a third class, who find themselves still unable to overcome temptation, much aid will be afforded by adopting the plan of hygienic and medical treatment above mapped out, and by diminishing, as the drugs mentioned can do, the force of the impulse itself, they may so reduce its power that a little additional resolution will suffice to achieve a victory. In this struggle they may find some support in the grand old maxim, "He that ruleth his own spirit is greater than he who taketh a city."

So many erroneous ideas have been promulgated in regard to what constitutes spermatorrhœa that it may be well to state that in the opinion of some of our highest authorities the recurrence of its prominent symptom once a week, or even twice a week, in young men of full vigor and health, not engaged in any excessively laborious mental or physical exertion, is only a sign of sound morality.

There is no doubt that serious temporary injury to health is produced by the evil influence of the cause of spermatorrhœa upon young persons of both sexes before and about the time of puberty. It has been called the contagion of scholars, and the results of vile precepts and still viler instruction render many large seminaries very dangerous places for innocent youth. Hence every effort should be made by parents and teachers to guard those under their care from moral contamination, and also, on suitable occasions, to warn them of the disastrous effects, which are only too liable to flow from abuse of the physical powers. It is well for parents

not to permit two boys or two girls, even of tender years, to sleep in the same bed, preventing it without assigning any reason, and teachers should not allow two scholars to be constantly in company in lonely situations. The possibility that every young man or young woman may fall under the influence of the contagion of bad examples should never be lost sight of, and parents or care-takers may often by judicious management, if constantly on their guard, obviate, in part at least, the ill effects of such mental contamination, not only without the child or youth being aware that his or her shameful secret has been detected, but also without the parents or preceptors being at all sure, even in their own minds, that they have penetrated to the cause of some otherwise unaccountable failure in health.

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## CHAPTER XIII.

### DISEASES PECULIAR TO WOMEN.

The diseases peculiar to the female sex comprise those of the uterus, ovaries and their appendages, the vagina, external generative organs and mammary glands. One of the most common groups of derangements belonging in this class is that of disturbances connected with the menstrual discharges or catamenia, commonly spoken of among females as the monthly periods. These may be absent constituting the disease called amenorrhœa, painful as in the malady named dysmenorrhœa, or too abundant as in the condition denominated menorrhagia.

#### MENORRHAGIA.

This is the one of these diseased states most frequently met with and is produced by a great variety of causes. The name is often applied indiscriminately to the superabundance of the discharge, a prolonged continuance of it, or an escape of blood from the uterine cavity at intervals of less than a month. As a rule, to which, however, there are many exceptions, the first of these varieties depends upon undue uterine and ovarian congestion, set up by some constitutional cause or general disease. The variety characterized by too long continuance may also be owing to general causes, but is apt to be induced by some local

disease, such as polypoid tumor of the uterus. The third variety, which is more correctly spoken of as metrorrhagia or uterine hemorrhage, is generally significant of the presence of some organic disease, such as cancer of the womb. The effects of this disease upon the general health, if it is at all severe, are only too well marked. The patients soon become pallid and feeble, low spirited, and restless at night. The digestive apparatus is disturbed so that there is more or less loss of appetite, nausea, or even vomiting and constipation. Œdema or dropsical swelling of the feet and legs is liable to come on in severe cases, and the bloodless aspect of the patient, with the attacks of fainting which occasionally follow any attempt to assume an upright posture, indicate at a glance the alarming condition to which the sufferers have been reduced by loss of blood in excessive quantities.

*Treatment.*—In the treatment of menorrhagia there are two indications to be fulfilled, first, to check the present hemorrhage, and second to remove the cause upon which it depends, and so obviate the certainty of its recurrence. To accomplish the first of these desirable objects, which should not, however, be attempted in any monthly period, until the usual amount of blood has been eliminated from the system, say until the second or third day of the flow, half a tea-spoonful of fluid extract of ergot, five grains of gallic acid, and a table-spoonful of infusion of matico every three hours, and the oil of erigeron in drop doses, can generally be depended upon. Rest in bed is, however, an important part of the treatment, without which all the good accomplished by skillful medical care may speedily be dissipated. If these remedies fail and the case is an urgent one, it may be necessary to tampon or plug up the vagina with pieces of raw cotton or linen cloth, taking care not to employ an undue amount of force in introducing these materials. If pieces of sponge or wads of cotton are used, they should each have a strong string securely attached to them, in order to facilitate their removal. In no case should such a tampon be allowed to remain longer than twenty-four hours, for fear of poisoning the system with the putrefying blood entangled in it. Indeed it is generally better to remove the plug at the end of twelve hours, thoroughly wash out the parts by syringing with tepid water containing a little carbolic acid, and then introduce a fresh tampon if demanded by the exigencies of the case.

In order to meet the second indication a thorough examination of the parts concerned must be made, either immediately or as soon as the flow has been temporarily checked, when it may be found that a uterine polypus exists, or that some organic disease of the uterus or ovaries is present. If such is the case, of course, the treatment advisable in these more serious maladies ought at once to be instituted.



### AMENORRHŒA.

This complaint is the direct opposite of the preceding, being essentially a complete stoppage of the monthly flow during the period of a woman's menstrual life.

Amenorrhœa may come on suddenly or be of gradual development. The former variety is often the result of some violent excitement, fright, or mental shock, due to the setting in of some fever or other acute disease, or to that common and very dangerous cause, especially in young girls, imprudent exposure to cold or wet during the monthly flow. The constitutional disturbance from abrupt suppression of the monthly period is generally very great. There is usually severe pain in the region of the uterus, similar in character to that of colic, and hysterical excitement, or even convulsions, and mania, may be the direct effect.

*Treatment.*—The treatment of such a condition is by hot mustard foot baths or hip baths, mustard plasters to the inside of the thighs, calves of the legs and ankles, antispasmodics, such as tea-spoonful doses of fluid extract of valerian, or of syrup of assafœtida, and opiates like a one grain opium suppository, the equivalent amount of laudanum by injection, or a hypodermic of one-sixth of a grain of morphia. When amenorrhœa comes on gradually it is apt to indicate some serious chronic disease, which should be immediately investigated and attended to by some skillful physician. The possibility that absence of the monthly flow may be due to pregnancy, in which case it would be dangerous and criminal to administer any of the usual medicines for restoring the discharge, must never be lost sight of. In cases where the cessation of the menses is part of such a severe malady as consumption or Bright's disease, it often appears to be only nature's method of economising the failing strength of the invalid, so that any interference would be likely to prove positively hurtful. On the other hand, the natural reappearance of the catamenia after a stoppage in the course of a chronic malady may be welcomed as a favorable indication of a tendency towards improvement. The treatment of delayed menstruation in young girls who have passed the age of puberty must be on general principles adapted to improving the general health, unless there are signs of the menstrual flux being retained inside the uterus, a dangerous condition which should always be considered in such instances, and relieved, if possible, early by surgical operation, with the strictest antiseptic precautions.

### DYSMENORRHŒA OR PAINFUL MENSTRUATION.

A woman who enjoys perfect health not only menstruates regularly, but does so with perfect freedom from suffering, but unfortunately there are very few members of the female sex who pass through the whole period of their sexual vigor without being called upon to endure more or

less frequently, attacks of dysmenorrhœa. Some women experience great pain with each flow, from the commencement of puberty, every month, for the thirty years, until the change of life relieves them. With the majority, however, pain is only the exceptional accompaniment. With some women marriage effects a cure, whilst in others, especially where there is sterility, it either aggravates or originates dysmenorrhœa.

The three well-marked varieties of dysmenorrhœa are the neuralgic, the congestive, and the mechanical. The neuralgic form affects especially those who are delicate and anæmic, or who have inherited or acquired a predisposition to nervous disorders. The suffering usually commences a day or two before the expected period, with headache and pain in the abdomen, which latter symptom increases in severity until the suffering is intense. In other instances, the pain comes on more abruptly, and is agonizing in its character at first; the flow, when it does appear, is scanty, but after a day or two the discharge becomes more abundant, and with this increase in the amount of the flux, a marked diminution of the pain is experienced.

*Treatment.*—The cure of neuralgic dysmenorrhœa is almost always tedious, and requires a careful study of the case in order to determine what organ or what system of organs is the primary cause of the deterioration of health, which is almost always present. As a general rule, however, tonics will be found to prove beneficial. During the attack of pain connected with the monthly period, the patient should sit in a warm hip-bath, as, for example, in a large tub of warm water, and if the suffering is very severe, may have a suppository of one grain of opium and one-sixth of a grain of belladonna, or a hypodermic injection of one-sixth of a grain of morphia. Great care, however, must be exercised in these cases lest the habit of taking opiates, or even an undue fondness for their employment should be established. Whenever grain-doses of extract of Indian hemp, bromide of potassium in quantities of twenty grains, or chloral in fifteen-grain doses will answer the purpose, they should always on this account be employed in preference to an opiate.

Congestive dysmenorrhœa generally comes on later in life than the form just described, and occurs more frequently in those who are plethoric or who suffer from some inflammatory affection of the uterus or ovaries. The remedies already recommended generally prove useful, but it may be necessary to bleed or purge freely, and in some cases the application of leeches to the mouth of the uterus, affords great relief. During the intervals between the periods, the patient should live plainly, avoiding stimulants and exciting food, and employing general laxatives to prevent the slightest tendency toward constipation. Long walks, dancing, and riding on horseback should be carefully abstained from.

Mechanical dysmenorrhœa is due to some narrowing of the neck of the uterus, which interferes with free outflow of the discharge.

This narrowing may be caused by spasmodic or organic stricture, by a tumor, or by a bending of the uterus so that the neck is compressed. Where the neck of the uterus is naturally deficient in width, the trouble may sometimes be remedied by dilating the channel with compressed sponge, or by incising it with an instrument contrived for the purpose. These operations, however, often fail to afford a permanent cure. During the attack, when the indications are to relieve the intense suffering which is experienced, the treatment is identical with that which has been already recommended in the other forms.

In some cases of dysmenorrhœa, enlargement and congestion of the ovaries appear to be important factors in the production of the malady. Such attacks are apt to be very intractable, unless the disordered condition of the ovaries can be remedied, but occasionally a pill of one grain each of Indian hemp, hyoseyamus, and camphor, or a suppository containing five grains of iodoform; is beneficial.

### LEUCORRHŒA.

This prevalent, troublesome, and disagreeable disease, vulgarly termed the whites, consists of a discharge of mucus or muco-pus from the uterus and external organs, very similar to that occurring from the nose during a cold in the head. In fact, the condition of the mucous membrane, giving rise to leucorrhœa, is often one of catarrhal inflammation. It may be brought on by taking cold, by local excitement, or more commonly by some deterioration in the general health. As ordinarily seen, it is not usually accompanied with much pain, but when very profuse, distress in the back, and a dragging sensation in the lower part of the pelvis, often described as a bearing-down feeling, are frequently complained of. The discharge is generally more abundant a little while before, and for two or three days after, the occurrence of the catamenia. In fact, when the leucorrhœa is severe, this increase of the flow of whitish matter sometimes continues for a couple of weeks after the monthly period, with increased violence, showing how greatly it depends upon a congestion of the parts concerned, for its production.

*Treatment.*—The treatment of this rather intractable malady, besides the necessary attention to the general health by the use of tonics, nourishing food, and so forth, consists in the employment of astringent injections into the vagina, using very dilute solutions of alum of thirty grains to the pint; twenty grains of sulphate of zinc, or ten grains of sulphate of copper; infusions of white-oak bark, half an ounce to the pint, and similar remedies. If much pain in the small of the back is complained of, a Burgundy pitch or hemlock plaster, applied across the loins, will often be of service. Where the leucorrhœa is caused by catarrhal inflammation of the cavity of the uterus, as is frequently the case, injections into



the vagina are, of course, almost worthless, and local applications, made by a physician, of tincture of iodine, or of nitrate of silver, to the mouth of the uterus, are very important, and should be faithfully persevered in, sometimes for many months.

### UTERINE DISPLACEMENTS.

The different forms of displacement of the womb give rise to a great amount of the suffering imposed upon the human female; but they rarely endanger life, and if not cured before, are apt to vanish entirely after, the disappearance of the menses—about the forty-fifth year.

PROLAPSUS OF THE WOMB is a descent of the organ below its proper position in the pelvis, and may occur in two different degrees. The term *prolapsus* is applied to any falling downward of the organ, which is not so great that the womb passes outside the body; whilst the latter, called *procidencia*, is that condition in which the uterus escapes partially or entirely beyond the external organs of generation. Falling of the womb is more apt to occur after maturity is attained, and appears especially in those who have led laborious lives, or who have exercised themselves too much in lifting or carrying heavy weights. Hence cooks, laundresses, market-women, and nurses, who lift and carry large and heavy infants, are especially liable to suffer from prolapsus. Women who have borne children are more frequently affected than those who are sterile, and lingering or instrumental labors, or getting up too soon after confinement, particularly predispose to it. Among the direct causes may be found congestion, hypertrophy, or tumors of the uterus. Violent bearing-down efforts in labor, straining in obstinate constipation, and forced respirations, such as occur in coughing, lifting heavy weights, and so forth, are also direct causes of falling of the uterus.

The symptoms of this complaint are sensations of fullness and weight about the pelvis, wearisome back-ache, and leucorrhœa. Menstruation is not usually interfered with, but irritation about the bladder, resulting in an annoyingly frequent desire to pass water, and obstinate constipation, are very common. The different displacements which occur are *prolapsus* or mere falling downwards, *anteversion* or tilting forwards of the body of the womb, and *retroversion*, in which the organ is turned partly over backward toward the rectum. It may also be bent or flexed in various directions. The recognition of these varieties requires, of course, an examination with the finger, and it may be the uterine sound, in the usual way.

*Treatment.*—The treatment is by the use of supporters or pessaries of different forms, as may be suited to the particular cases. Besides the employment of these, however, the leucorrhœa should be held in check, and so prevented from further debilitating the patient, by astringent

injections, such as have already been advised. When, as is frequently the case, a relaxed condition of the general system has much to do with the trouble, every effort should be made to restore tone and energy to the vital processes of repair of the tissues by the administration of iron, quinine, and strychnia, as advised in anæmia; good, nutritious food, and a suitable amount of fresh air and exercise, which latter must be of such a kind as will not tend, by jolting or jarring the body, to aggravate the existing displacement of the uterus. In the use of a pessary, it should be a cardinal rule that the moment it increases the discomfort, it is doing harm, and ought to be at once removed. Serious ulceration of the internal generative organs has frequently resulted from too prolonged retention of pessaries after they have given this warning of their evil effect. The treatment of procidentia of the uterus, when the womb comes entirely outside the body and hangs more or less loosely between the thighs of the sufferer, is often unsatisfactory, the various surgical appliances and operations not remedying the difficulty as well as could be wished. In this, as in many other cases, it is infinitely better to use the ounce of prevention, in the shape of a pessary, on the first signs of prolapsus, than to wait to apply the pound of cure.

### POLYPUS OF THE UTERUS.

This disease, which is one of the most common causes of excessive hemorrhage from the womb at the monthly periods, coming on late, that is, within a few years of the time of change of life, is therefore of considerable importance. The term polypus is employed to designate especially a tumor which is attached to the inner surface of the uterus by a well defined neck or pedicle. The importance of this distinction will be seen when treatment of these morbid formations is considered. The structure of such growths may be either dense, firm and fibroid, or soft and almost gelatinous, similar, to a certain extent, to those already spoken of as occurring in the nose and ear. The most prominent symptom of a polypus in the uterus is profuse menstruation. After a time, as the tumor grows larger, and becomes more of an irritant, there are likewise frequent discharges of blood between the periods, often amounting to attacks of flooding. The new growth, also, by its irritating effect upon the mucous lining of the uterus, or vagina, gives rise to an abundant leucorrhœal discharge, which may become like thin pus or sanies. Moreover, as the polypus increases in magnitude, its presence is more or less resented by the neighboring organs, and the patient begins to suffer from tenesmus, from a frequent desire to pass water, and other similar symptoms of irritation. Occasionally, there are paroxysms of pain, resembling that of an abortion, in which it is probable that the irritated uterus makes a blind effort to contract and expel the offending substance which has developed

within it. All these indications, however, can only give rise to a suspicion of the presence of a polypus in the uterine cavity, and the exact diagnosis should be made as soon as possible by a skillful examination by the finger, by the uterine sound, or by dilatation of the mouth and neck of the womb, so that, with the aid of the tubular mirror called a speculum, it is possible to see distinctly up into the uterus and determine the exact character of the disease. So long as the tumor remains in the uterus or vagina the patient is in constant danger of serious hemorrhage, which, though it rarely causes death immediately, is often, by producing profound anæmia, the indirect cause of a fatal result. Unless, therefore, the operation of removing the polypus is performed, this disease is almost hopeless. But modern science, by devising this remedy, has vastly improved upon the medical skill of the first century, when the woman who was so miraculously cured of the issue of blood which had lasted twelve years, had in vain spent all her living upon physicians. The method at present adopted is, after properly dilating the neck of the uterus, to pass a wire ligature around the pedicle, and tighten it gradually, until the growth is cut off, generally without much loss of blood, and, being performed under ether, with very little pain. The operation, as a rule, results in complete cure.

### FIBROUS TUMORS OF THE UTERUS.

These are sometimes seated in the substance or on the external surface of the uterus, and may attain an immense size, sometimes becoming very large without giving rise to as much serious discomfort as might be expected. They are not apparently under the control of medical treatment and can only be benefited by surgical operations.

### DISEASES OF THE OVARIES.

The two glands of the female called the ovaries, situated in the lower part of the abdomen on each side just above the groins, and enclosed each in a layer of peritoneum at the back of the broad ligaments which support the womb, are the seats of various forms of disease. The ovary itself is a very vascular structure, with a cellular network, enclosed in three layers of membrane called the capsule. In the cellular substance of the ovary are a number of small vesicular bodies, called the Graafian vesicles or ovisacs, which contain an albuminous fluid, much granular matter, and the human egg or ovum, which is cast off, as a rule, every month during menstruation, and if vivified by impregnation becomes the new being which continues the species.

The most common diseases of the ovary are inflammation, cancer, and cystic growths, the latter constituting the dangerous disease, ovarian dropsy.



Inflammation of the ovary, which is characterized by the severe pain situated deeply in the groin, with great tenderness on pressure and an enlargement of the organ, that may often be detected by the touch, is to be treated by perfect rest in bed, saline laxatives or injections, followed by enemata of thirty drops of laudanum in a table-spoonful of thin starch, or one-grain opium suppositories, and local anodyne applications, such as laudanum fomentations. In severe cases leeching over the inflamed glands may be required. In the subacute or chronic forms counter-irritation by tincture of iodine, or small blisters near the seat of pain, is very useful. Ovarian cancer and other tumors, and ovarian dropsy, which is usually associated with them, can only be remedied by surgical interference, which, though formerly believed to be rarely justifiable, has now become by the wonderful improvements made in the art, and especially by the aid of the antiseptic method, an eminently proper mode of treatment. In fact the wonderful success attained by some in the operation of ovariectomy constitutes a marvelous triumph of modern surgical skill, and has been the means of rescuing hundreds of females, who without it would have been doomed to lingering and painful deaths. Some of the latest champions of this procedure claim to have been successful in more than two-thirds of all their cases.

### UTERINE PREGNANCY.

It has been well said that every pregnant woman should be looked upon as a laboratory in which nature is performing that most wonderful of all her miracles, the fashioning of a new human being, and that nothing should be allowed in any way to disturb or derange this most important operation. Could such an idea be constantly kept in mind not only by mothers themselves, but by all those who surround or even momentarily approach the female who is performing the most sublime duty of her sex, that of continuing the race, and every effort made to aid her in accomplishing this great function in the most perfect manner possible, what vast improvements might be looked for, even in the next generation of mankind.

The first indication of pregnancy is generally the stoppage of the monthly periods, and it is also one of the most reliable of the early indications. It should be remembered, however, from the beginning of our consideration of this condition that there is no certain sign of pregnancy, none which has not been found to fail, and lead into errors which were profoundly mortifying, if not worse, up to the time when the heart of the infant can be heard to beat through the walls of the mother's abdomen. This beat of the child's heart can seldom be positively identified before the fifth month, and often not until the sixth. It is well known that Queen Mary of England, so infamous under the title of Bloody Mary,

sure that she was pregnant and even confident that she felt the active movements of the child within her body, made all the preparations for her confinement, but happily for the cause of the English Protestants in vain. In some instances pregnancy may occur and yet the monthly flow continue. This is quite common for one or two months, and less frequent for four or five. In fact, some mothers assert that the first intimation they had of being pregnant was quickening or feeling the motion of the child, which generally makes itself evident about four and a half months from the date of conception. Hence, whilst the absence of the monthly discharge cannot be looked upon as a sufficient proof of the existence of pregnancy, it is nevertheless when occurring in a healthy woman, who has previously menstruated regularly, a strongly presumptive sign of the pregnant condition, and in conjunction with the other symptoms to be mentioned presently greatly assists in coming to a correct conclusion in regard to any particular case.

Morning sickness occurs with most females for the first few months of pregnancy, and some females when pregnant suffer intensely from it. It usually comes on whilst dressing, not being felt on first getting up, and when not very severe often passes off later in the day to recur, however, the next morning. It differs from other forms of sickness, such as those which are due to disease of the stomach itself, in that as soon as the vomiting is over the patient is often perfectly well again, and can take food immediately afterwards. A sick pregnancy is generally considered a safe one, and as a symptom, in conjunction with the cessation of the catamenia, it has much weight. The sensitiveness of the stomach to odors and flavors, and the peculiar ease with which feelings of nausea are brought on by such impressions, is a very significant sign, and rarely fails, if supported by the other usual symptoms, to indicate pregnancy when it is well marked.

Changes which occur in the mammary glands are valuable corroborative signs. They consist in the enlargement and puffiness of the nipple, the darkening and increase of size of the areola, and occasionally the secretion of milk. These indications show themselves during the second and third months.

Quickening is the feeling of the movements of the child, which is so constantly noticed by the mother about the end of four months and a half, or just half way through the pregnancy, that it often helps to fix the time of the approaching confinement. The first sensation is described as being like the fluttering of a bird, or the creeping of an insect, but after a few weeks it becomes progressively more decided, and more perceptibly like the struggles of an infant with human arms and legs. The popular idea that up to the time of quickening the child in the womb is not alive is, of course, totally erroneous, because if the infant was not living from the very day of conception it would not grow and develop.



It is only felt primarily at this period because before the date of quickening its struggles have been too feeble and made too deeply in the cavity of the abdomen to be perceptible.

The following changes take place in the shape and size of the abdomen: In the early months of pregnancy the abdomen is often even flatter than in the unimpregnated female, but after the period of quickening enlargement occurs, and in the latter months becomes so great as to cause, in many instances, a good deal of distress by mere pressure, distension, and weight. The stretching of the skin necessary to render it capable of covering the uterine tumor generally gives rise to numerous cracks in its surface, which remain as whitish scars through after life. Enlargement of the abdomen may occur from causes such as dropsy, ovarian tumor, or the accumulation of gas in the intestines, so that alone it is by no means a conclusive sign of pregnancy.

Changes in temper and disposition, longings for strange and unsuitable food, drowsiness, toothache, heartburn, palpitation of the heart, and so forth, are less constant and therefore less reliable symptoms of pregnancy, some of which, however, occur in a large proportion of the cases.

So many domestic arrangements depend upon the date of confinement that the question of the duration of pregnancy is one of great importance. Unfortunately no absolute rule has ever yet been discovered, and from experiments upon cows, in which the average period is curiously enough the same as that of the human female, it seems probable that none exists. These observations upon a large number of animals, in which the exact date of conception was known, showed that the calves were dropped at periods varying from two hundred and sixty to three hundred days afterwards. It is probable that in the human species similar divergence from an assumed standard exists, and that, like the apples upon a tree, some specimens will ripen and drop off a week or two earlier, and some a week or two later, than the average date of maturity for the whole crop. This average date is usually considered for the fruit of the womb two hundred and eighty days, or forty weeks, or a week over nine calendar months, from the day of the cessation of the menstrual discharge when last seen at the commencement of pregnancy. In order to be able to make this calculation accurately it is a good plan for every married woman to keep upon a calendar a regular account of the day in each month when she ceases to be unwell, so that if at any time before the next period impregnation should occur, she may have at hand the precise datum upon which to base her preparations. The date of quickening, when that is a prominent symptom, as is the case in most pregnancies, ought also to be carefully noted.

*Hygiene.*—The general management during pregnancy is that of good hygienic care of the house we live in, as pointed out in the first section of this book. During pregnancy all the precautions there urged are



more than doubly important, because that wonderful house is now occupied by a second, and perhaps even a third tenant, far more delicate and far more sensitive to any disturbance than its comparatively strong and self-protecting previous inhabitant. If, as many moralists hold, it is a sin to abuse the bodies which have been entrusted to us by indulgence in luxury, intemperance, or any other injurious practice, what a grievous crime must it be if a mother, for the sake of any mere temporary gratification of appetite, or worldly fashion, violates the dictates of hygiene, and so brings down the penalties of outraged sanitary law not only upon herself, but also in the shape of sickness, suffering, and perhaps premature death, upon her innocent, unborn child. The maternal instinct, that most beautiful and most powerful of the redeeming traits of poor humanity, has often caused a mother to risk gladly her very life for that of the baby in her arms, and surely if she realized its importance, every woman worthy of the holy name of mother would eagerly yield up all of the momentary pleasures, at least during the period of her pregnancy, which entice her, for the sake of securing health and vigor for the infant which she bears. Hence the pregnant woman should ask herself, before making even a trivial variation from habits of life, which have been proved by experience conducive to her individual health, "can this change produce any injurious effect upon the future, mental or physical, of my darling baby?" and unless the answer is unequivocally in the negative, it is her duty to refrain from incurring unknown risks by alteration of diet, exercise, sleep, clothing, and so forth, which, previous experience has taught her, contribute most effectually to the preservation of her perfect sanitary condition. The amount of food taken into the system during the early period of pregnancy, as intimated by nature in the broad hint of morning sickness, should be rather less and of a more easily digested quality than at ordinary times. But in the latter months, when the infant is rapidly developing and material must be supplied for muscles and bones in abundance, the quantity of aliment should be largely increased. It is better, however, to eat more frequently than to run any risk of over-loading the stomach at such a time. The amount of exercise should also be ample, since this is vitally important for the proper assimilation of food into the blood, whence it is transferred to the fœtus in the womb, and contributes, of course, every atom of the material composing the little body. Care must be taken, however, to avoid violent exercise of any kind for fear of bringing on abortion with all its dangers to the mother, and in the earlier months with certain destruction to the child. As regards the production of blemishes and deformities in the infant by mental impressions of the mother during pregnancy, there is a large amount of evidence that such an effect, if it is ever produced, is extremely rare, and that many of the stories of such occurrences are grossly exaggerated or totally without foundation. At the same time a calm and

equable frame of mind is greatly to be desired during the whole period, and anything which is likely to operate in the direction of causing mental shock, depression, or excitement, should be scrupulously avoided.

*Treatment.*—Among the diseases of pregnancy are excessive vomiting, which may be treated with only moderate success with table-spoonful doses of lime-water, iced carbonic acid water, or iced champagne, ginger, bismuth, hydrocyanic acid, and two grain doses of oxalate of cerium; heartburn, from which half a tea-spoonful of bicarbonate of soda, or ten drops of aromatic spirits of ammonia affords relief; constipation, which must be meddled with very cautiously by the aid of mild saline laxatives, such as a tea-spoonful of Rochelle salt, a desert-spoonful of castor-oil, or injections of soap and water; and piles, the discomfort of which can be palliated only by the use of some such ointment as that already recommended. If toothache comes on care must be taken that sound teeth are not extracted in the vain hope of relieving it. When teeth decay rapidly in pregnancy it seems sometimes to be due to the removal of the bony materials for the purpose of building up the skeleton of the fœtus, and efforts should be made by supplying the lime salts as phosphates or hypophosphites mixed with the food to remedy the difficulty. Finely powdered bones have been shrewdly recommended. Enlargement of the veins of the legs should be treated by bandages or elastic stockings, and dropsy of the feet and ankles should lead to an immediate examination of the urine, lest some tendency to albuminuria may be threatening. Should such prove to be the case it must be met on the general plan directed on page 556. Irritation about the bladder, perhaps with incontinence and retention, occasion much inconvenience, but can often be relieved by gentle laxatives and diuretics, such as the cream of tartar, or, if very troublesome, by a belladonna and opium suppository. The patient should, however, be guarded against the possibility of becoming fond of the action of anodynes, especially opium or chloral, at this trying time.

## LABOR.

When the half-hoped for, half-dreaded termination of the weary months of waiting approaches, preparations should be made for the confinement, in order that no external circumstance may aggravate the pangs of travail, and the anxieties of the puerperal state. The lying-in-chamber should be large enough for suitable ventilation, and yet not so large as to be with difficulty heated. Every precaution to secure for the invalid a full supply of unpolluted air should be instituted, and conveniences for affording hot water at short notice are of importance. The bed should be a hair or spring mattress, which ought to be covered with some water-proof material; over this a thick, old spread or comfortable, to absorb the blood and other discharges, should be laid, and this again covered with a sheet.



The remaining bed-covering must be arranged according to the season of the year. In this room should be collected all the clothing which will be needed for the comfort of the mother and expected infant, and besides the articles of every-day use there should be provided a strong sheet, which can be tied around the post at the foot of the bed, for the patient to pull upon during her pains, a firm cushion for her to press her feet against if she so desires, an abundant supply of towels, plenty of soap and warm water, a pound or so of lard free from salt, a few yards of flannel, a soft, warm shawl or small blanket to receive the baby in before it is washed, sharp-edged but blunt-pointed scissors to cut the cord or navel string, eight yards of coarse sewing cotton doubled eight times and knotted at the two ends for tying the cord, a binder of strong new muslin about a yard and a half in length and half a yard wide, or larger if needful, and a paper of large strong pins for fastening the same around the invalid's abdomen after she is delivered. The dress of the patient should be the usual chemise and night-dress rolled up around her waist, so as to keep them from being soiled, and a sheet folded in four and pinned around her limbs as a skirt, fastening it at the right side so that it can easily be unpinned and slipped down out of the way when the labor is completed. During the first stage of labor the patient may walk about the room, sit up in a chair or lie upon a lounge, as is most agreeable to her, but when the mouth of the uterus is dilated to the size of a silver half dollar she should take her position upon her left side, with her hips near the edge of the bed, and about a foot lower down than she is accustomed to lying. In this posture the medical attendant can best aid her in her trial until toward the end of the process, when some advantage is often gained by placing the patient upon her back. Preparation of the nipples should be made by washing them with strong green tea, or solution of a dram of tannin in two ounces of cologne water, twice daily for three weeks before confinement, in order to harden the skin and render it less liable to crack and become sore whilst nursing.

The period of actual labor, that commonest yet most sublime operation of nature, is generally ushered in with slight griping pains in the abdomen, and more or less aching in the back, which come on at first, perhaps, at intervals of half an hour, lasting for a minute at a time; then at intervals of ten or fifteen minutes, and so on until they grow severe and the space of respite between them dwindles to five, four, or even three minutes. There is a singular analogy between the variations of these waves by which the process of labor is accomplished and the waves of the sea-coast. As the tide rises, wave after wave comes in, some larger and some smaller, but every third, fourth, or fifth, being a little higher than the others and rushing up the beach with greater force. In the same way labor pains come on in varying intensity, but with a general tendency to augmented violence in the third, fourth, or fifth, and all the time there is a gradual,



almost imperceptible, increase in the average force until the highest tide is reached, and by the supreme effort delivery is accomplished.

Labor is generally described as being made up of three stages: The primary stage extends from the first real labor pain until the time when the bag of waters is burst by the violence of the expulsive efforts; the second stage dates from the rupture of the bag of waters, which usually marks the time when the mouth of the womb is sufficiently dilated for the child to pass, to the complete delivery of the infant; and the third stage is the time occupied in the delivery of the placenta or after-birth.

In the first stage of labor the pains have a cutting or tearing character, and are commonly felt in the stomach, or lower part of the abdomen, and also in the back. They are accompanied by a frequent desire to pass water, produced by the pressure of the child's head upon the urinary bladder as it descends, and often by a disposition to evacuate the bowels, from a similar cause. Pressure of the head likewise frequently produces severe cramps in the legs, which may be partly relieved by friction, but often disappears as the labor progresses. The duration of this stage varies greatly, but in a labor of twelve hours' duration, the usual proportion would probably be ten hours in the first stage, an hour and three-quarters in the second stage, and fifteen minutes in the third. First labors are generally the most tedious, and average probably twice as long as subsequent ones, doubtless on account of the greater relaxation of the tissues concerned in the process, after the first baby is delivered. Labor has sometimes been accomplished in civilized life in less than half an hour, and on the other hand, labors of two, and three, or even four, and five days' duration, are by no means unprecedented. This terrible aggravation of parturient suffering in civilized life is attributed by the author of these pages partly to inherited narrowing of the pelvic straits, and partly to the inherited increase of the diameter of the child's head, rendering it relatively too large to pass through the bones of the pelvis, which not being proportionately expanded by centuries of culture, are no longer exactly fitted for the duty they have to perform in the process of continuing the race. (See Introduction, pages 44 and 45.)

In the second stage of labor the character of the pains and the expulsive efforts which accompany them, is changed. They now become what are commonly called bearing-down pains, in which the patient almost instinctively endeavors to aid the contractions of the uterus in its efforts to empty itself, by straining as if at stool; and, indeed, should she seem reluctant to yield to this disposition, she ought to be instructed to bear down exactly as if her bowels were being moved whilst constipated. The cries emitted are generally more like prolonged grunts, and can be readily recognized at a considerable distance by one who is familiar with their peculiarities. After a continuance of these pains for one, two, or more hours, the child's head, if that comes first, as happens in probably nine-

teen out of every twenty cases, begins to press upon the external parts or vulva, and finally, with an unusually forcible pain, often with a piercing cry from the mother, her baby's head emerges into the world. As a rule, the next pain expels the shoulders and hips, the rest of the body offering little resistance to the expulsive efforts of the womb after the head is born.

The third stage, consisting in the delivery of the placenta, is usually attended with one or two slight pains, by which the after-birth is forced out of the womb into the vagina, whence it must usually be removed by the medical attendant.

Although in the majority of cases any intelligent person could successfully manage a case of labor, there are numerous accidents, mal-positions, and complications, which may occur without any warning in any particular case, so that if skilled medical assistance can possibly be procured, it should by all means be sent for. The man or woman who neglects this runs a terrible risk of being the murderer of the mother, or of the child, perhaps of both.

But if no qualified physician is procurable, the acting midwife should from time to time, say every ten minutes during the second stage of labor, anoint the vulva or external parts of generation of the patient freely with lard, at the same time examining very gently, with the finger, what progress is being made in the descent of the head, supposing, as is usually the case, that forms the presenting part. The moment the head is born, the finger should be repassed in around the infant's neck so as to find out whether the navel-string is wound around it, as not unfrequently happens. If such is the case, the cord should be pulled down a little, and the mother urged to bear down, for the child's sake, as rapidly as possible, and complete the birth; when the cord must be immediately loosened and slipped over the baby's head to save it from strangulation. At the same moment the head of the child comes into the world, the midwife's other hand should be placed upon the lower portion of the mother's abdomen, and the uterus pressed upon gently. As the body of the child is born, the uterus should contract to the size of a ball, apparently about five inches in diameter, and if this does not take place, the womb should be firmly grasped through the walls of the abdomen in the hand, and so stimulated to due contraction. This is very important, because, if it does not occur promptly, the patient may bleed to death in a very few minutes. As soon as the womb is found to be properly contracted into this hard ball, attention should be turned to the child. If it cries at once, the cord may be immediately tied an inch and a half from its attachment to the infant, with the sewing-cotton already provided, and then cut half an inch above this again, that is, half an inch further away from the child, squarely off. The baby is then to be lifted up, with *both* hands clasped around its body, for it is very slippery, and received by an attend-



ant in the flannel or old blanket, which has also been prepared. The attendant ought either to hold it until the labor is completed, or to place it on its left side, in some safe situation, preferably in its cradle or crib, not in an arm-chair, where it may be crushed to death by being sat upon.

During this time the midwife should keep her hand upon the patient's abdomen, gently pressing and kneading the womb occasionally, in order to promote the recurrence of a contraction, strong enough to expel the placenta. As long as the after-birth remains the woman is not safe from dangerous or fatal flooding; but whilst the uterus continues firmly contracted, and feels like a hard ball under the fingers of the midwife, there is but little danger. After five or ten minutes, if slight pains come on, the mother should bear down a little, and the cord be gently pulled upon, when, in many instances, the placenta comes away. As it reaches the vulva, the patient should be told to cease her efforts, and the midwife should twist the after-birth round and round on itself, eighteen or twenty times, gradually withdrawing it at the same moment. This is to wind the membranes, or bag which held the water into a string, if possible, inside the vagina, and perhaps the uterus, so that they may all come away with the placenta in safety. The mass, when removed, should be laid away for subsequent careful examination, in order to determine whether any part has been left in the mother, as the effects of such an accident are much to be dreaded.

The attention of the midwife should be, however, immediately returned to the mother, and her hand at once applied again over the abdomen, when the womb ought to be felt as a ball of some three inches and a half in diameter, or about the size of the new-born baby's head, and even harder than before. If not so felt, firm pressure and friction over the abdomen must be made to induce it to contract. Should it not do so within a minute or two, the midwife must introduce her hand up the vagina into the cavity of the womb, and pulling out the clots of blood she will probably find there, strive again to excite the womb to its proper contraction. Should these efforts prove unavailing, not a moment is to be lost, for the next five minutes will perhaps cost the patient her life by flooding. Let, therefore, a piece of ice, a sponge dipped in vinegar, or a peeled and gashed lemon, be carried up with one hand and rubbed around inside of the womb, whilst the other hand of the midwife, by firm pressure and friction over the patient's abdomen, contributes to stimulate that uterine contraction in which lies the mother's only safety. As soon as this is accomplished, as it probably will be by these remedies, a tight bandage should be pinned around the patient's body, with two or three folded napkins beneath it, pressing upon the part of the abdomen over the womb, to prevent relaxation, which happily seldom occurs when thus treated. After being securely bandaged, the patient may be lifted up a little, out of the wettest part of the bed, if it can be done without any



effort on her part; but for fear of flooding, the more quiet the parturient female is kept for the first two hours after labor, or until the blood has had time to clot firmly in the large, open-mouthed veins of the uterine cavity, the less is her danger. When the patient is made as comfortable as possible, a clean napkin, loosely folded, is to be placed between the thighs, but not pressed up tightly against the vulva, lest it act as a plug and prevent the detection of flooding, should that come on.

In case the child does not cry when first born, its mouth should be carefully cleared of mucus and other obstruction, and a little cold water sprinkled upon its breast, or spurted over it from the mouth of the midwife. Should this fail in arousing a gasping effort at breathing, the baby, still attached to the cord, if that is pulsating, should be put into a basin of very warm water, and after a minute or two, when the surface of its body is well heated, the dash of cold water over its face and breast again tried. If still unsuccessful, the baby should be wrapped up in hot flannels, and artificial respiration, by blowing into the mouth whilst the nostrils are held, and then forcing the air out by compressing the chest, attempted as a forlorn hope. The writer has found the results of dry heat, applied by cautious roasting before a fire, promising enough to warrant further employment in otherwise hopeless cases.

If, on the contrary, the child cries lustily, and the mother is doing as well as can be expected, the cord should be again examined to verify the fact of its being securely ligated, and the baby given its first bath. The infant should be rubbed all over with lard, to soften the *vernix caseosa* or cheesy matter with which it is more or less covered, then well washed with white castile soap and milk-warm water, and thoroughly dried. The cord is dressed by being drawn through a hole, cut in the middle of a piece of soft old linen, folded once, and trimmed to four inches square, and after being wrapped in this, is laid upward on the baby's stomach, and bound in place by a belly-band of silver flannel, fitted snugly but not too tight, and secured by safety-pins, or a few stitches.

The management of labor when the back of the head does not come down first, and especially when the buttocks, feet, or arms present, is so apt to be difficult and dangerous that a physician ought always to be summoned, even from a great distance and at the utmost inconvenience, should any signs of a "cross-birth," as it is popularly called, be detected, or should unusual delay in delivery render obstruction probable. It will sometimes be a comfort to a woman in labor who is anxiously awaiting the physician's arrival to be reminded that if the birth comes before the doctor it will be because everything is all right, whilst on the contrary, if there be anything wrong, the physician will usually have ample time to reach her before his services are actually needed.

The management after labor should be such as will best avoid any excitement, either mental or physical, liable to light up inflammatory

action in the uterus, which has just been the subject of such momentous change. The patient in ordinary cases ought to keep in bed until the tenth day, eat nothing but semi-solid or liquid farinaceous food, such as gruel, panada, or corn-starch, until the fifth day, and have her bowels gently moved by a small dose of castor-oil on the third day. She should see no company for at least two weeks, but devote all her energies to the task of recovering as speedily as possible, both on her own account and for the sake of the frail, new life so utterly dependent upon her care.

### PUERPERAL DISEASES.

Among the diseases of the puerperal state may be mentioned after-pains, which, though seldom troublesome subsequent to first deliveries, may in others cause more suffering than the labor itself. They can, however, be greatly relieved by the use of ergot just as delivery is accomplished, and of one grain opium suppositories, or forty drop laudanum injections, or a Dover's powder, in two or three hours if they persist. Soreness of the nipples and cracked nipples are very apt to come on in patients with tender skins from the constant irritation of the baby's gums in nursing, and are unfortunately very difficult to heal, because the same irritation which originated the trouble in the first place is continually kept up. Vaseline, zinc ointment, laudanum, and nitrate of silver sometimes succeed in curing the sore, but the most successful plan is to use a wooden shield with a rubber nipple if the baby can be persuaded to consent to the innovation. The great danger of cracked nipples is that they may lead to abscess of the mammary glands or gathered breast, which is a cause of terrible suffering. It has sometimes been apparently prevented by the faithful use of the extract of witch hazel.

Puerperal fever is a very dangerous disease which seems to be generally the result of contagion, either from some previous case or from erysipelas and scarlet fever. Hence every care should be exercised by physicians, nurses, and others, to avoid the possibility of being the means of disseminating this terrible malady. The affection is apt to come on about the fourth or fifth day after delivery, with a violent chill, great thirst, and prostration of strength. The uterine discharges or *lochia*, which should persist for a week or ten days, quickly dry up, and diarrhoea with obstinate vomiting frequently sets in. The mind soon grows clouded, low muttering delirium makes its appearance, and the patient often dies on the third or fourth day of the attack, in a condition similar to that observed in typhus fever, as described in the article upon that subject. A large majority of the cases prove fatal, but full doses of twenty or thirty grains of quinine with heroic doses of a grain of opium, or one-sixth of a grain of morphia, every two hours, and free stimulation as required, succeed in saving a small proportion of the patients. The one important

thing to be remembered about puerperal fever is to scrupulously avoid the cause.

Puerperal mania is a form of insanity liable to come on a week or ten days after confinement, in which there is frequently a singular aversion to the child, and perhaps to the husband also. A tendency to suicide is also prominent, and patients thus affected should be watched with the most unremitting care. Under perfect rest, nourishing diet, moderate stimulation, and sedatives, persons generally recover.

Puerperal convulsions may come on before or during labor, as well as in the month following delivery. They are generally due to accumulation of urea in the blood, the consequence of temporary Bright's disease, resulting probably from the pressure of the uterus containing the fœtus upon the kidneys. The treatment has already been pointed out under the head of uræmia on page 557.

Milk-leg is an inflammation of the lymphatics of the limb, coming on especially towards the end of the second week after labor and deriving its name from the milk-white appearance usually presented by the skin of the affected part. As the febrile state of the system is apt to cause drying up of the milk, it was formerly supposed that in some mysterious way the lacteal fluid was transferred to the leg. At first it may be quite painful, but after the integument becomes accustomed to distension, the sensations are rather those of weight and discomfort than of positive suffering. The treatment is by laudanum or turpentine fomentations at first, and later with stimulating and anodyne liniments, which hasten a little the naturally tardy convalescence. The ordinary duration of the affection is from a month to six weeks.

### MANAGEMENT OF THE INFANT.

Although most of the maladies of infancy are identical with those affecting older persons, and are to be treated, after due allowance is made for the delicacy and sensitiveness of the infantile organization, according to the rules laid down in other portions of this volume where the management of adult diseases is detailed, there remain a few complaints which are almost peculiar to this period of existence, and therefore call for special notice in the present section.

After a baby has received its first bath, and been for the first time introduced to the mysteries and miseries of clothes, it should be put to the breast, for the purpose of extracting whatever nourishment nature has there provided for it, and also as the commencement of its education in the art of nursing, a business upon which its life for some months will depend. Curiously enough, whilst some children take hold of the breast as if by instinct, others must be taught to nurse, and show for this vital operation all the perverse unwillingness of Shakespeare's schoolboy, notwithstanding it is the one thing in the world they have to do. Every



mother ought, if possible, to suckle her own infant, not only for her own sake, but for that of the child. Statistics show that babies nursed by their mothers, amid the unfavorable surroundings of prison life, thrive better than those who are brought up by hand in healthy country districts outside, and no woman in good health who can furnish the nourishment, should be spared the reproach of risking the life and health of her offspring if she refuses to perform her maternal duties in this regard. A mother undertaking the suckling of her infant should, moreover, do so with a mind fully alive to its importance, and with a firm determination that no pleasures of society or of fashion shall interfere with its conscientious performance, or else she had better not attempt it at all.

The amount of milk contained in the breast, especially with the first child, is very small for two or three days, but in some forty-eight hours the rush of milk, as it is called by nurses, commences, and is often attended with some fever, and marked pain and soreness in the breasts. The remedy for this disturbance in the mother's system is, however, very simple, and conveniently at hand, and as the child, which, if healthy and vigorous, generally has a good appetite, draws out the milk which nature has provided for its special benefit, all these uneasy sensations soon subside. If the coming in of the milk is unusually delayed, it may be necessary to give the baby a little cow's milk, well diluted and sweetened with white sugar; but this is seldom required. During the time a mother is nursing her infant, every care should be used to avoid any violent mental excitement, or shock, which is exceedingly apt to influence the secretion of the mammary glands to a certain extent, just as it does that of the lachrymal gland, and render the lacteal fluid temporarily unwholesome or poisonous to the infant; or it may completely suppress the secretion of milk, with very serious consequences to both the parent and her offspring.

If, for any reason, the mother is unwilling or unable to suckle her infant, the next best chance for the baby's life is to procure a good wet-nurse. When such an alternative is adopted, great care should be exercised in selecting the foster-mother, and the physician's advice ought always to be obtained upon this important subject.

Should the mother fail to nurse her child, and no good wet-nurse is procurable, the child must be brought up by hand, a species of manipulation which contributes, it is probable, more than anything else to swell the lists of infant mortality in most large cities, as well as to some extent in country districts. Although goat's milk is used occasionally in this country as an infant's food, practically the choice is narrowed down in most cases to cow's milk, and the great object should be to secure this from healthy animals, pure, and free from all admixture, as pointed out in an earlier chapter upon milk as an article of diet, on page 187, and in a perfectly fresh condition. All milk used for the feeding of young infants, especially in the summer, should be carefully tested, and partic-

ularly in regard to its acidity, with litmus paper. If found to be acid, it ought to be at once rejected, and a sample of pure, sweet milk obtained.

A new-born infant may be put to the breast every hour or so, but after the first four days it should be suckled only eight times daily, and, as far as possible, at regular intervals. These intervals should be gradually increased until, at the completion of its eighth month, the baby takes but four meals in each twenty-four hours. The time for weaning, generally about the age of nine months, should be determined partly by the growth of the teeth, presuming, of course, that the mother's health is not suffering in the mean while. When the first lower middle incisor teeth appear, which usually happens about the sixth or seventh month, the mother may begin to diminish the number of times for suckling more rapidly, at the same time replacing the breast-milk, of which the infant is deprived, by cow's milk thickened with oatmeal, barley or wheat flour, and so forth. After the child has four teeth, it should be weaned, although if the infant is feeble or the season unfavorable, the period of nursing may be extended a few months longer.

If the new-born baby is not nursed, and fresh cow's milk is employed, it should at first be diluted with half its bulk of pure, tepid water, sweetened with a tea-spoonful of sugar to one-quarter of a pint of milk, and a few grains of salt. Condensed milk will not require sweetening, but should be freely diluted so as to resemble human milk in color. For the first month of a child's life it may be mixed in the proportion of one part of the condensed milk to ten or twelve of warm water.

The most rigorous cleanliness of the nursing-bottle must be insisted on, and if a flexible tube is comprised in the feeding apparatus, it must be cleansed with especial care.

Hence, whether nursed or fed, the food of the infant up to six months old should consist of milk, and if the child appears to prosper, it ought not to be supplemented by, or mixed with, farinaceous food.

When a child does not seem to thrive well upon pure or diluted cow's milk, it has often been advised to resort speedily to mixtures of milk with meat broths, raw eggs, and so forth. Bretonneau reported, as early as 1818, that when children under his care who were suffering with *tabes mesenterica*, were fed with milk and meat broth, they rapidly improved, and other authorities recommend this mixture as the next best thing to woman's milk.

Hennig's egg drink, which is a very useful resort in the nutrition of delicate infants with feeble digestion, consists of about six ounces of boiled water with the white of a fresh egg beaten up with it at the temperature of 100° F., and a little salt; or if the child is three or four months old, the yolk of the egg may be added, and half of the water replaced by sweet cow's milk. This mixture answers very well in many cases of *diarrhœa* and *cholera infantum*, when cow's milk is not tolerated at all.

In fact, the beaten up white of egg may be employed advantageously as an addition to any kind of infant's food when there is diarrhœa. Dr. Jacobi recommends a similar mixture composed of the white of one egg, a cupful of barley water, a pinch of salt, and a little sugar, in severe cases of gastro-intestinal summer catarrh, and claims to have saved many a baby's life by its use. In instances where debility is a very prominent symptom from ten to twenty drops of brandy may be added to each six ounces of the compound.

The vegetable substitutes for breast-milk nearly all belong to the farinaceous articles of diet.

From careful experiments we may conclude, first, that even in the first week infants can digest starch in small amounts; second, that in a few months after birth such vegetables as contain starch in moderate quantity may be used as additional infant food.

Among the cereals, barley, oats, and wheat, are in the order named most suitable to infants, because of their relatively larger amounts of the protein elements and smaller quantity of starch. Dr. Jacobi states, however, that oat-meal contains a larger percentage of fat and mucin, and consequently has a greater tendency to relax the bowels. He therefore recommends that we should administer barley to those children who manifest a disposition towards diarrhœa, and oat-meal to those in whom a tendency towards constipation exists, changing from one to the other according as the condition of the bowels seems to require. He further maintains that milk diet is unsuitable in diarrhœa, and that, therefore, when barley is employed to rectify looseness of the bowels, it is advisable to temporarily reduce the quantity of milk present in the nourishment, or to temporarily abstain from its use altogether. In such cases the raw white of egg, with or without brandy, may take the place of milk. The barley should not be pearled or deprived of its husk, because a share of the protein elements is contained in the cells occupying the outer layers of the grain. It is better to use commercial barley, and either grind it before cooking in a coffee mill, or boil it for several hours so as to burst the seeds, and then by straining with strong expression get rid of the excess of starch.

Mothers are often very justly anxious to find some remedy for the painful and obstinate constipation from which their darlings suffer. Exclusive of those cases in which it is due to feeble peristaltic action, in consequence of imperfect development of the involuntary muscular fibres in the intestine, constipation depends chiefly, first, upon an excessive amount of starch in the food and may be cured by simply withdrawing the superabundance of starch, or giving it in the form of oat-meal; second, it may be due to an excess of casein in the food, which may generally be recognized in the stools, in which case it can be overcome by boiling the milk and mixing it with barley-water, wheat, or oat-meal gruel, and so forth;



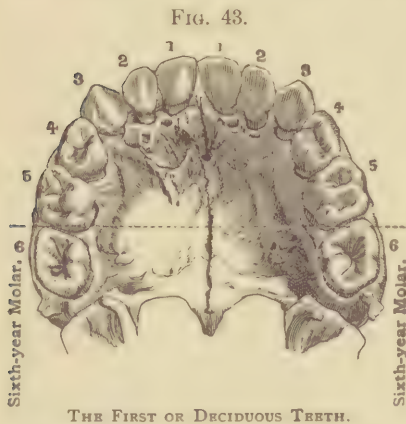
third, constipation may arise from deficiency of sugar in the food, and this is, of course, readily rectified by sweetening the milk more thoroughly, or by administering a tea-spoonful of syrup or molasses and water once, twice, or three times daily, as may be found requisite.

The special diseases of the infant during the first few months of life, which require notice, are, first, the baby's sore mouth, which, as already stated, is probably due to the irritating effect of the minute fungi from the air upon the lining mucous membrane of the oral cavity, where they afterwards flourish harmlessly throughout the life of the individual. It is to be treated with a wash of borax, or a powder of equal parts of borax and white sugar, but is seldom troublesome; the eruption of strophulus, called by nurses red gum, or red gown, for which a laxative of molasses and water, or a tea-spoonful of sweet oil, may be administered; and colic, for which a mixture of five to ten drops of the tincture of oil of anise, in a tea-spoonful of syrup of asafœtida, is better than the catnip and other teas of sovereign virtue, so plentifully poured down the innocent baby by old-fashioned nurses.

With a vast majority of children, the first real troubles of their lives begin with the eruption of the teeth. This process usually commences between the fifth and seventh month after birth, and consists in the gradual rising up of the teeth, and the absorption of the spongy bones, and then of the gums overlying them, until the dental furniture appears

in the mouth. There is no positive rule in regard to the order in which the teeth make their appearance; but it is common for the teeth in the middle of the lower jaw to come through first, often the central pair at the same time, or within a few days of each other. The next to follow are the corresponding teeth in the upper jaw. After this the order is more variable.

The marginal illustration gives a view of the upper jaw of a child at the age of six or seven, supposing that none of the deciduous teeth, as described on page 141, have been lost.



The central incisors, marked 1, 1, in the cut, generally come through the gum between the fifth and eighth months. They are followed by the two lateral incisors, marked 2, 2, forcing their way up between the seventh and tenth months of life. Next by the two canines, marked 3, 3, in the figure, appearing between the twelfth and the sixteenth months. Afterwards by the first molars, indicated by 4, 4, coming out between the fourteenth and twentieth months; and lastly, by the second molars, the eruption of which takes

place during the third year of childhood. It is thus evident, that with the corresponding number of teeth making their way through the tissues of the lower jaw, during the same period, a constant supply of irritation in the system is provided for by Mother Nature in one of her step-mother moods, and the most watchful care is necessary to correct, as far as possible, the evil effects of this great disturbing cause in the infant organism. It is true that some babies, whether from natural insusceptibility to disturbing influences, or from some other conditions unhappily not yet discovered, experience but little trouble from the first dentition; but, as a general rule, there is a good deal of suffering, rarely appreciated by older persons, unless they have themselves been the subjects of pain in the eruption of the wisdom-teeth, such as, happening to Sir Humphrey Davy, by a fortunate accident just at the right time, led to the invaluable discovery of anæsthesia, by nitrous oxide, and ultimately of the value of those priceless blessings to suffering humanity—ether and chloroform. This irritation of teething expresses itself in the child's system by a tendency to nervous diseases, due to reflex action, as explained on page 418, and especially in hot weather by a disposition to diarrhœa, constituting cholera infantum. The general principles which should guide us in treating this common and fatal malady of childhood, have already been referred to in the article on diarrhœa; but the vital importance, in many cases, of striking at the root of the disease by lancing the gums of the baby, whenever they are found to be red, swollen, and painful, as directed on page 532, cannot be too urgently insisted upon. It is probable that faithful use of the gum lancet in this way, and strict watchfulness in regard to the child's food, as heretofore pointed out, would be the direct means of saving thousands of infant lives in the United States annually, which are now wasted through gross ignorance and neglect.

*Treatment.*—In mild attacks of cholera infantum a mixture containing a grain of precipitated chalk, a grain of subnitrate of bismuth, ten drops of paregoric, twenty-five drops of syrup of ginger, and half a tea-spoonful of mucilage of gum arabic, may be administered to a baby one year old, twice or thrice daily. In severer forms, this preparation can be given every two or three hours; and in bad cases it may be necessary to substitute the paregoric by a drop of laudanum and ten drops of syrup of krameria, or to resort to the other more powerful astringents directed on page 544.

The remaining diseases of childhood, comprising the eruptive fevers, such as scarlet fever, measles, chicken-pox, and the like, have already been considered in Chapter V., on pages 309 to 326, inclusive. (For true and false croup, consult pages 502 and 441.)

## CHAPTER XIV.

### DISEASES OF THE CUTANEOUS SYSTEM.

THIS class of affections comprises diseases of the skin, hair, and nails, and therefore includes numerous maladies which are the cause of much distress and deformity, but are seldom dangerous to life. General recognition of skin diseases is, of course, easy; but the distinctions between the different forms is often a matter of great difficulty. The most important classes are the erythematous, which are eruptive in their character; the catarrhal, in which the condition resembles, to a limited extent, that of a mucous membrane in inflammation; the vesicular, composed of small blisters; the pustular, made up of pustules or small boils, containing matter or pus; the papular, in which pimples containing neither water nor pus appear; the scaly eruptions, in which the affected parts are covered with dry, whitish layers of epithelial cells; and lastly, the skin diseases caused by animal and vegetable parasites, of which the itch is a remarkable illustration. Only a few of the maladies arranged in these numerous groups are common and require detailed description here.

**ERYTHEMA** is the name applied to the redness of a superficial inflammation of the skin, and is probably the mildest form of cutaneous disease. The simpler varieties are very apt to occur with most fat people in hot weather, and infants generally are affected with it about the flexures of the joints. For treatment see next article.

**NETTLE-RASH** or **URTICARIA** is an erythematous affection which sometimes comes out quite suddenly, and is attended with a most troublesome itching. It is characterized by the formation of "wheals" or rounded patches of elevated skin, whiter than the surrounding parts, which are slightly reddened at the margins. It may arise from the bites or stings of insects; from the eating of certain fish, especially shell-fish; or from reflex irritation, and other causes. It is greatly aggravated by scratching, and, like simple erythema, is relieved by dusting with finely-powdered oxide of zinc and starch, with lycopodium, or even with rye flour. Lotions of lead-water, benzoic acid, and borax, are also sometimes useful. If fish or other unwholesome food is the cause of the trouble, it must be got rid of by emetics and purgatives, and other causes of irritation should be sought out and corrected likewise. (600)



ECZEMA, sometimes called moist tetter, is a catarrhal inflammation of the skin usually attended with a breach of surface. It presents at first irritable, raw, red patches, with occasional little blisters which soon break and a fluid is discharged, which in drying form crusts or scabs. Later on the patches become dry, scaly, and often cracked. This is a form of skin disease which is often seen in young infants, in whom it sometimes receives the name of the milk-crust. The pain, burning, and itching of eczema are intense, and yet it is only aggravated by scratching. It is especially apt to appear about the flexures of the joints, as, for example, in the hollows of the elbows and knees. At first soothing lotions, such as lead-water, and zinc, or camphor in fine powder with starch, do the most good, but later, ointments of the ammoniated mercury, or very dilute ointment of the red oxide of mercury, of, for example, ten grains of the oxide to an ounce of lard, are useful, and still later, when the skin is dry itching, and scaly, tar ointment may be resorted to. When of gouty origin eczema is apt to be benefited by the internal use of colchicum, and the other varieties often yield readily to arsenic, which may be given in the form of five drops thrice daily of Fowler's solution after the first acute stage has passed.

HERPES, which is a good type of the vesicular affections of the skin, is characterized by little blisters which come out in small groups, and when appearing about the mouth and nose, constitute the cold-sores with which almost every one is familiar. A severe form called herpes zoster, or the "shingles," comes on with smarting and burning pain in a belt half way around the body of large patches of the eruption. It is distressing and tedious, often lasting a month or six weeks, but rarely dangerous. The popular idea that it will prove fatal if it goes all around the body is without foundation. The only treatment is to apply anodynes and soothing lotions, such as the morphia and lead-water recommended in erysipelas, and administer opiates to relieve the pain.

PEMPHIGUS is another vesicular eruption, characterized by the formation of large blisters, from half an inch to two inches in diameter, resting on slightly reddened surfaces, and mostly attended with severe itching. These blisters sometimes appear on the fingers, but commonly attack the lower limbs. They generally indicate a more or less impoverished state of the system, in which iron, quinine, strychnia, and good nutritious food are called for. Arsenic is also very useful, and locally soothing ointments or absorbent powders may be employed.

IMPETIGO is the most common of the pustular eruptions, and is characterized by the formation of separate pustules, somewhat like those of small-pox. They may attack any part of the body, but are most apt to appear upon the face and limbs. This disease, like ecthyma, which in many respects it resembles, seems as if it were an aggravated form of impetigo, and is especially frequent among children, although adults are

not exempt. **ECTHYMA** is always associated with general debility, defective nutrition, or hygienic neglect. The treatment is by good food, tonics, with codliver oil, and strict attention to cleanliness. Soothing applications, such as Goulard's cerate, should be made first to the pustules, but later on a very mild mercurial ointment is more effectual.

**BOILS**, those common and exceedingly troublesome afflictions upon mankind, are classed under the head of pustules. With all the advances we have made of late years in pathology, the cause of boils still remains undiscovered. Sometimes they seem to be due to high living, and in other cases poor diet appears to determine the advent of a troublesome series of these pests. One boil is very apt to precede a crop of fifteen or twenty, although there is no certainty that this will be the result. The best way of managing a boil is to poultice it with flax-seed or bread and milk, containing laudanum to ease the pain. If the boil is small, the poultice may be spread upon a piece of oiled silk, which prevents it from becoming dry, and held in place by a bandage, or by a square piece of linen upon each corner of which has been daubed a little spot of adhesive plaster, the stick of plaster being melted in the flame of a candle for the purpose. This holds a dressing of any kind on a broad, flat surface of the body, as, for instance, the skin of the back, very satisfactorily. When the boil softens in the centre, and the fluctuation of matter can be detected, or its yellowish color can be seen under the skin, some twenty-four hours of suffering may be saved by having it lanced, and the pain of the cut may be abolished by freezing the surface with ether spray, or by stroking it with a little bag containing a mixture of ice and salt. In certain cases it is important to lance a boil early, so as to prevent the burrowing of the pus towards some important structure; but ordinarily, if the sufferer dreads the knife, there is no actual necessity for using it, and the boil may safely be left to break of its own accord, under the poultice, one, two or three days later than the time when it is ripe for lancing. Lancing the little pimple, with which a boil first commences, exactly through the middle, which can be done almost painlessly under the ether spray, will nearly always cut short this troublesome affection. Ten or twelve grains of quinine daily, so as to produce slight cinchonism for a week, occasionally breaks up a course of boils, but is by no means an infallible remedy.

Carbuncles chiefly differ from boils in the larger area involved in the inflammation, from which a core of dead, connective tissue, called a "slough," several inches in diameter, may come away. Carbuncles are apt to come on the nape of the neck, and on the back, but may appear on any part of the body. A large carbuncle will sometimes keep a patient in bed for a month or six weeks, and the pain and exhausting discharge wears out the strength so much that it may cause death; if a second of large size appears, after the first begins to heal, as is not very unusual, it quite frequently proves fatal. Poultices of flax-seed meal, bread and milk,



powdered slippery elm bark, or of yeast; anodynes to relieve pain; and six grains of quinine daily, with other tonics to support the strength, constitute the appropriate treatment. Early and free incisions into the inflamed tissue, made after freezing the part, are probably of great service.

The PAPULES or pimples are solid elevations of the skin, containing neither water like the vesicles, nor pus like the pustules. They are three in number, including strophulus, the red gum or tooth-rash peculiar to infants, lichen or prickly heat, and prurigo.

STROPHULUS consists of an eruption of innumerable small, reddish pimples, which occurs for the most part on the face, neck, and arms of young children. The irritation and general disturbance is slight. The eruption is usually caused by digestive derangement of some kind, as, for instance, that of cutting a tooth, and passes away with the cessation of its cause. The only treatment necessary is some mild, saline laxative, and a lotion of very weak solution of carbonate of soda, five or ten grains to the ounce, with a tea-spoonful of glycerine, to allay the itching if that appears to be very troublesome.

LICHEN is very common in hot weather, in the simple form of reddish pimples, which itch a good deal but usually subside on the approach of the cooler season. It sometimes takes on a severe form, and may even become chronic. In mild cases tepid baths, plain and easily digested food, an occasional saline laxative, with a table-spoonful of infusion of gentian, and five grains of bicarbonate of potash or soda internally, three times daily, will effect a cure. To relieve the itching, solutions of borax, vinegar, or carbolic acid, may be used with advantage. In aggravated cases the more powerful tonics, with table-spoonful doses of cod-liver oil and one-sixteenth of a grain of arsenic three times a day must be resorted to.

PRURIGO is characterized by an eruption of pale, slightly elevated pimples, mostly situated on the trunk of the body, and attended with very intense irritation, especially at night, so that the marks made by the patient's nails in scratching can almost always be seen, and aid in recognizing the malady. It is frequently the result of the presence of the vermin with which so many dirty people are infested. Cleanliness, by the aid of strong alkaline baths, and the use of an ointment of carbolic acid, or of white precipitate, with the administration of tonics and good food will generally effect a cure. Sometimes, however, the disease, unless it is carefully treated early, proves very obstinate, being kept up in great measure by the constant scratching, which it is very difficult for the patient to abstain from.

PSORIASIS is the most important scaly eruption; in certain of its varieties it probably constituted one form of the leprosy of the Bible. It is characterized by the appearance, at first, of oval or rounded patches of slight irritation, then upon these an eruption of scales, which grow dense



and white towards the centre. Afterwards the spot expands from its outer edge, where the skin is often reddened and slightly raised above the level of the surrounding surface. This is the skin disease to which the name of "dry tetter" is commonly applied. In the worst or inveterate form, the whole body may be covered with these white scales, except the face, the palms of the hands, and the soles of the feet. Even these do not always escape. The incrustation of scales in this variety of psoriasis is thick and dense. When it has lasted for some time the skin chaps and breaks, after which there is severe soreness with exudation of fluid from the broken surface, intense irritation and itching, with great general and physical exhaustion, lasting for many weeks, or perhaps months. In rare cases it may even prove fatal. In the milder form, it is especially apt to appear very symmetrically upon the knees and elbows, and is most common between the fifteenth and twenty-fifth year of life. It is prone to recur in a patient who has once manifested it, but is not contagious. Often it is hereditary, and may be associated with a gouty or rheumatic taint in the system. The treatment consists of careful attention to diet, avoidance of alcoholic stimulants, and the administration of arsenic in the form of Fowler's solution, five drops thrice daily. Externally soothing lotions or ointments are required in the first stage, and mild mercurial or tar ointments are of service after it has become chronic.

PITYRIASIS is a squamous disease especially apt to affect the scalp when it appears in the milder form, giving rise to the shedding of an immense number of bran-like scales, resembling an exuberant crop of dandruff. Frequent washing, with the use of a borax lotion, or white precipitate and tar ointments, will generally remedy the trouble. A rare variety of pityriasis, affecting the whole body and generally proving fatal when in the chronic form, is also described.

The skin diseases dependent upon syphilis have already been detailed, and those of scrofula are chiefly of the types above mentioned, aggravated by the taint existing in the system.

Hypertrophies of the skin are all unusual diseases, except WARTS and CORNS, which are common enough to make up for all the rest. The coming and going of warts on the hands is as much a mystery now as in former ages, when the most ridiculous remedies were gravely prescribed. Warts can be destroyed by caustics, of which nitric acid is the most severe and effectual, and chromic acid perhaps the least painful. When arising from the poison of syphilis, they are sometimes extremely sore and troublesome, so much so as to require removal by surgical operation. Corns are similar to warts in their structure, except that they have a much thicker layer of epidermis over their surface. They are almost always produced by the pressure of tight shoes, and may be avoided by caution in this respect, as already pointed out on page 249. They can usually be prevented from giving much trouble by carefully

trimming out the centre of the corn at short intervals, or by wearing one of the various forms of perforated corn-plasters in common use. In cutting a corn, the incision should never go through the epidermis, so as to cause bleeding, since dangerous inflammation has thereby been set up. Often filing a groove across the top of the corn with a coarse, half-round file, answers every purpose, and is not attended with any risk. A **BUNION** is generally made up of a corn, on the side of the great toe, and an irritated synovial sac or bursa beneath it. It is also the result of wearing too tight a shoe, especially such as are too narrow at the point. When inflamed, it should be soothed with lead-water and laudanum; a loose shoe, or one with a piece cut out of the side, being worn. After the reduction of the inflammation, benefit may be obtained by painting with tincture of iodine. A bunion should never be neglected, as it is liable to suppurate, leaving a troublesome indolent sore, which may for years cripple the patient, even if permanent lameness does not result.

**PRURITUS** is a very common disease of the skin which is characterized by itching without any eruption or other apparent change in the appearance of the part affected. Children and elderly people are particularly apt to suffer thus, and the localities involved are generally those about the orifices of the body. Sometimes, like prurigo, it may be traced to the irritation caused by vermin, usually the *Pediculus corporis* or body-louse, which may be gotten rid of by attention to cleanliness and the application of weak mercurial ointment, a tincture of lark-spur, or various other home remedies. When not thus produced, the cause must be sought in some deterioration of the general health. As local applications, lotions of borax, half an ounce to the pint, or of carbolic acid, one or two teaspoonfuls to the pint, and ointments of zinc with camphor, belladonna or morphia, are useful.

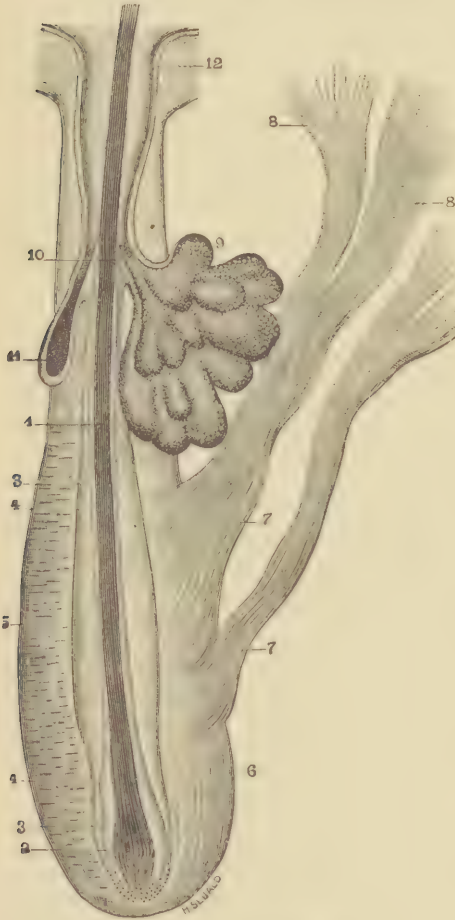
**FRECKLES** consist of a deposit of oxide of iron from the blood, just beneath the epidermis or in its lower layers. They may often be dissipated by painting with tincture of iodine, or by a cautious use of the weak solution of nitro-muriatic acid.

**SEBORRHOEA** and **ACNE** are the diseases of the glands of the skin which require consideration. In seborrhœa there is an excessive production of secretion, made up of oily matter and cast-off epithelial cells, which accumulates upon the surface in the form of thin, yellowish scales. It is especially common on the skin of young infants. The layers of scales may be removed by the use of white castile soap and warm water, and if there is no inflammation of the skin, a mild carbolic or white precipitate ointment may be used to prevent their return.

**ACNE**, commonly called pimples or flesh-worms, coming, as it does, upon the face just at the time when young people of both sexes begin to feel most anxious about their personal beauty, gives rise to a far greater amount of unhappiness than many of the serious maladies to which flesh

is heir. It is an inflammation of the sebaceous glands of the skin upon the face, back, and elsewhere, which comes on in successive crops, and gives rise to the spotted and pimply countenances which are often so unsightly or even repulsive. These sebaceous glands, one of which is well delineated in the accompanying wood-cut, are generally situated, as

FIG. 44.



A MAGNIFIED SEBACEOUS GLAND.

there indicated, by the side of a hair, and if inflamed, cause by the pressure they exert, when distended, an inflammation of the surrounding derm constituting the pimple of acne. In the figure is exhibited a hair in its follicle, highly magnified. At 7 and 8 appear the curious little muscles which have the power of erecting the hair in conditions of sudden fright or horror. They are, as is well known, much more active in animals—for instance, the cat—than in mankind. 9 and 10 indicate a large, and 11, a small, sebaceous gland, both opening on the skin by the side of the shaft of the hair at 12. The small, black spot generally visible near the centre of an acne pimple, is popularly supposed to be the head of a flesh-worm, which can be squeezed out by pressure at the sides of the papule. In reality, however, the yellow thread which looks like the body of a worm, is only the hardened secretion of a sebaceous gland, the top of which, being exposed to the air, has collected dust and dirt, and so become black.

*Treatment.*—No advantage is gained by squeezing out these little plugs of fatty matter, as in most cases the bruising of the parts more than compensates for any benefit afforded by the relief of internal pressure in the pimple from retained secretion. A great many local applications for the cure of acne are offered for sale, some of which are composed of powerful poisons, and are liable to do great and permanent injury. A safe and often useful lotion is made of precipitated sulphur, variously combined



with mucilage of sassafras-pith, glycerine, and camphor; or an ointment of precipitated sulphur, with vaseline, a dram to the ounce, or white precipitate with vaseline, half a dram to the ounce, may be employed. The most important part of the treatment is attention to any general derangement of health, especially of the digestive apparatus, or, in females, of the menstrual function. Errors in diet will often bring out a crop of acne, and articles of food which contain fried butter or fat of any kind, appear to be apt to have this effect. Pastry of all varieties, particularly mince-pie, buckwheat and other hot cakes, sausage, cheese, and nuts, should all be avoided, as well as spirituous and malt liquors in every form. Although the treatment and hygienic care, as thus advised, will generally diminish the activity of the eruption, they may not always effect a cure, and consolation must be sought in the fact that it seldom persists, unless kept up by imprudence, after the period of maturity in the organism has been attained.

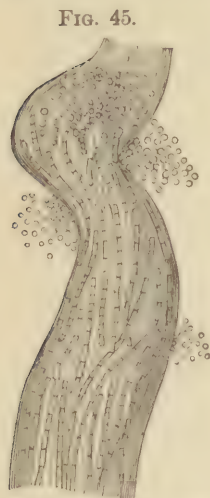
#### SKIN DISEASES DUE TO VEGETABLE PARASITES.

This curious group of maladies, in which the human body bears the same relation to certain microscopic plants, that the oak does on a large scale to the mistletoe, has been of late years the subject of much study and dispute. It is now, however, generally admitted that the fungus growths found so constantly in and among the epithelial scales of the epidermis, are the causes, and not the mere accompaniments, of the diseases in question. The development of fungus not only invades the skin, but affects also the hair, and the hair-follicles. Though the variety of vegetable growth differs in the different diseases, each presents the same general features, consisting of microscopic threads named mycelium, corresponding to the stem of a larger plant like a grape-vine, and microscopic seeds sometimes produced in bunches like grapes, and called spores. The minuteness of these spores has already been described, when speaking of the germ theory of disease, on page 280, in the chapter on contagion. The full recognition of the fact, as it is believed to be by the present writer, that the fungous growth is the essential cause of the whole disease, is vitally important, because upon it depends the system of preventing these maladies from spreading to healthy persons, by total destruction of the spores or seeds of the respective diseases. Some eminent authorities contend that the recipient of one of these cutaneous affections must be diseased, or at least not in full health, before the spores of the fungi in question can find a suitable soil in his skin for their development. This doctrine appears to the writer a dangerous one, because it would lead physicians and others, who feel strong and well, to neglect safeguards which might otherwise protect them from these complaints. It appears, also, totally erroneous, because experience teaches that just as the most lux-

uriant health will not of itself protect a human being from being bitten by a rattlesnake, or burrowed into by an itch insect, so it is no invincible shield against the attacks of our vegetable enemies, although there is no doubt that when the constitution is enfeebled, and vitality stands at a low ebb, these diseases, as is the case with many others, flourish with greater luxuriance. In the instance of a member of the author's family, a little girl was infected with the fungus of *Favus* just underneath the tip of her chin, probably from spores left by some diseased child on the sill of a car window, from which she had been looking out, and at the time of being attacked with this complaint, which was fortunately recognized at once, and put an end to by appropriate treatment, she was in perfect health.

**TINEA TONSURANS** OR **RING-WORM OF THE HEAD** is the most common of these vegetable parasitic diseases. It shows itself as a dry, scaly patch, rounded or oval in outline, which gradually grows larger and larger, the hairs dying and dropping out at the centre, so that ultimately a bald spot of from half an inch to two inches in diameter is left. The same fungus which produces this malady in the head sometimes develops among the hair of the beard, producing what is called *tinea sycosis* or barber's itch, and upon the other parts of the body where it is denominated *tinea circinata* or common ring-worm, with which, however, no worm

has anything to do. The name of ring-worm, so commonly applied to this disease, no doubt gives rise to many popular errors in regard to it, and it should be fully understood that a child infected with ring-worm of the scalp is a walking flower-garden, and not necessarily a menagerie, although wild beasts *may* be roaming about his head besides. Ring-worm of the scalp commences usually as a little pimple, which soon spreads and takes on its characteristic ring-like appearance, showing a circle of minute scales, pimples, and vesicles at the circumference of the patch. As the disease advances the hairs included in the circle become dull, dry, twisted, and easily broken off, whilst the epidermis and stumps of the hairs become covered with a greyish white powder, consisting chiefly of the vegetable growth. If one of these broken hairs is put into a drop of caustic potash solution, and examined under a high power, such as 250 diameters, of the microscope, its shaft can be seen as represented in the figure, penetrated with the mycelium of the fungus, called the *trichophyton tonsurans*, and floating around may often be detected separate spores of the same plant as indicated at the upper part of the woodcut on both sides of the hair.



THE EFFECT OF RING-WORM ON THE HAIR.

**TINEA CIRCINATA** which is also denominated *herpes circinatus* and ring-



worm of the body, begins like that upon the head with a small pimple, but soon spreads with great rapidity, and the rings of eruption may attain a diameter of four or five inches. The great characteristic by which this affection can almost always be recognized is its healing up in the middle, so that the appearance is presented, after a time, of a patch of healthy or slightly reddened skin, surrounded by an angry, red ring about a quarter of an inch wide. Such an arrangement of the eruption is peculiar to ring-worm and suggests that the fungus in its growth at the centre of the ring has exhausted some material found in the skin which is necessary for its development. Were this not the case it would almost certainly continue to flourish in the middle, as well as at the edges, so that the course of ring-worm affords a strong argument in favor of that part of the germ theory which supposes that the immunity conferred by one attack of small-pox, for instance, is due to the exhaustion in the entire system of some ingredient necessary to the growth of the specific small-pox fungus. See page 279.

TINEA SYCOSIS OR BARBER'S ITCH is the variety of the disease in which its vegetable cause happens to develop upon the chin of an adult, male patient. A great amount of irritation is usually set up, perhaps, from the roots of the hairs constituting the beard, extending more deeply into the substance of the true skin, and the plant therefore producing a deeper seated inflammation of the parts as it grows down along the sides of the hair-follicles, than in the non-hairy portions. Hence large papules, and even pustules resembling those of acne in its aggravated state, are apt to be formed, and the itching and burning, as well as the disfigurement, are occasionally very troublesome to the patient. Perhaps among the vegetable parasitic diseases there is none to which persons are more liable to be exposed than this tinea sycosis, or as it is commonly called the barber's itch, so that a few words in regard to the special prophylaxis of the affection are appropriate.

As before observed, any one of the innumerable epidermic scales, continually shed from human integument and constantly floating in the atmosphere around us, whence they are deposited with other materials in the form of dust, may be freighted with spores, or seeds enough of the fungus which causes tinea, to infect thirty, forty, or fifty individuals should they meet with proper conditions for growth and reproduction. If persons fully realize this truth they can, of course, readily understand that all the ordinary precautions usually resorted to in barber's saloons, to wit, those of having separate cups, razors, and brushes, for each individual customer, only *diminish* the danger of infection, and by no means insure a certainty of escaping the disease. For not only is the air of the room liable to carry separate epidermic scales, which may each convey the infection, but many of the operations connected with the process of shaving are still more likely to be the means of communication. For instance, the razors



which are employed, even if they be individual property, are all sharpened with the same strap, upon which may have been spread, a few moments before you enter to be shaved, a few score epithelial cells from a case of tinea, one or two of which, should they accidentally adhere to the surface of your razor, as it certainly is quite possible for them to do, would be amply sufficient to implant the disease upon your face. In like manner the towels which are used, the brushes and combs, and even more certainly the hand of the barber himself, may prove the most efficient carriers of contagion which could possibly be devised.

To show how certain it is that the fungus of this disfiguring malady is readily conveyed from diseased persons in some or all of the modes just indicated, a few instances from the multitude that are recorded may be quoted. A gentleman of Boston consulted his physician a few years since for sycosis of several months standing, the sequel of a ring-worm of the face, coming on after being shaved, contrary to his usual custom, at a barber-shop. On learning (for the first time) the nature of the disease and its contagious character, he informed the physician that his wife and child were probably affected with the same malady, and, on examination, several well-marked ring-worms were found on the face and arms of the former, and one large ring upon the face of her infant. In another case a man acquired ring-worm in a neighboring city at a barber-shop, at which several others, according to their account, were similarly infected. He had not been diseased more than a few weeks, during which time several new rings appeared, before the young lady to whom he was engaged to be married also consulted her physician for relief from a well defined ring-worm upon her cheek. The possibility of contact with the face of her fiancé was not denied.

In order to prevent the spread of these vegetable parasitic diseases the precautions already suggested must be rigidly enforced. All articles of clothing which have been worn in contact with parts of the body where the parasite grows should be purified by immersion in boiling water, or, if the nature of the material does not permit this, by baking at a heat of 250° F. All bed linen, bandages, brushes, combs, and towels, or other articles suspected of similar contact, should be treated in the same way, and, of course, should be used by no other person until thus purified. The patient, if a child, should be kept by itself as far as possible, and those having charge of the case should thoroughly wash themselves after handling the parts affected. It is probable that the use of a strong carbolic acid soap, or of sulphite of soda or chlorinated soda solution would add to the security against attack, and with such precautions there is little danger that the malady will be transferred to others. Of course after proper treatment has once been put into operation, the danger of infection is still further diminished.

Other, and generally quite unsuspected sources of contagion are the

inferior animals, which are often the subjects of vegetable parasitic diseases. In the writer's practice cases have been met with which confirmed certain curious observations of Dr. Salisbury some years since in regard to the infection of children with ring-worm from playing with diseased kittens. These observations are also in exact accordance with the investigations of Bazin, who relates the following case, which, like some others which have been epitomized, is very instructive, as pointing out a source of danger which children especially should be guarded against by teaching them to avoid contact with certain of the inferior animals when they are diseased. A dragoon is reported to have applied at a Paris dispensary affected with *tinea circinata* of the front of the right forearm. He stated that five or six of his comrades, as well as himself, had contracted this affection from grooming diseased horses. A visit to the barracks showed three horses with round, bald patches, absolutely identical with *tinea tonsurans*. These patches were seated upon the withers, shoulders, back, and belly. The hairs in the centre of each patch were broken off close to the skin, and there was a whitish, squamous, crust-like production, which was traversed by the hairs. The presence of spores was detected by the microscope. The dragoon who exhibited the horses likewise showed his daughter, a girl of eight or ten years of age, the side of whose nose exhibited a patch of *tinea circinata* or ring-worm. Dr. McCall Anderson, who has paid much attention to the occurrence of vegetable parasitic diseases among the lower animals, and their transmission to man, also mentions several authenticated cases which have come under his notice. Among them are the following: First, a dog had a patch of *favus* upon one of his fore paws, as proved by microscopic examination of a portion of the crusts. This dog was in the habit of killing mice, some of which, on being caught, proved to be affected with *favus*, the *achorion schoenleinii* being found under the microscope. Another instructive instance was that of a woman and her child, who came to Dr. Anderson's dispensary with *favus* of the non-hairy parts of the body. The father and two other children were similarly affected. Mice, previous to this, had abounded in the house where these people lived, and a cat was procured to kill them. On examining the cat, numerous *favus*-cups were detected on the tops of its fore paws, no doubt derived from the mice she had caught. In a third series of cases, an eruption was noticed on a little girl, and soon afterwards her sister, mother, the baby, and the work-girl were similarly affected. The disease proved to be *favus*. On inquiry, it was discovered that a number of mice had been caught in the house, and had been much handled by the children. Several of the mice, still remaining, were then caught and examined, and on the back of one of them, near the tail, a characteristic *favus*-cup was seen, whilst the sides of the ears and head of another were eaten away by the disease. On the crusts being examined with the microscope, the *achorion* was detected in great abundance.



In order to make a positive diagnosis in one of these parasitic diseases, it is necessary to resort to the microscope, and this is the more important because, when it is once determined that the whole malady is the result of a local irritant only, no fears need be entertained about curing it promptly, on the score of danger from driving it into the system, or poisoning the blood.

*Treatment.*—The essential point in treatment is to apply to the roots of the hairs a preparation which will kill the fungus, just as weeds are destroyed in an asparagus bed by sowing the ground with salt. In order to do this, the hair—if any exists—should first be removed, and the surface made as clean as possible. When the hair is not very thick, or has already been nearly destroyed by the disease, a cure may perhaps be effected by lotions or ointments of sulphurous acid, carbolic acid, or salicylic acid. An ointment of verdigris is a favorite home remedy, and often succeeds after causing a good deal of unnecessary irritation. Tincture of iodine, applied twice a day, for fourteen days, and the spot then covered with the ointment of corrosive sublimate, of about two grains to the ounce, is an effectual method of treatment, which may be employed with great caution in obstinate cases. Where the hair is very thick and strong, it is sometimes necessary to pull it out with tweezers, as will be directed in speaking of favus, although this severe operation is, happily, not often required.

*TINEA FAVOSA* or *FAVUS*, called also scald-head and honeycomb ring-worm, is characterized by its peculiar dry, sulphur-yellow crusts, in the form of little cups about a quarter of an inch in diameter. In advanced cases, however, these cups run together, so that their well-defined form can, perhaps, with difficulty, be recognised, except at the edge of a patch. A peculiar mouse-like odor is emitted from a child's head bearing a good crop of favus, this being probably produced by the spores of the fungus coming in contact with terminal branches of the olfactory nerve of the observer. On careful inspection, each cup is usually seen to surround a hair, and there is commonly little trouble in detecting the fungus spores and mycelia on microscopic examination.

Although this disease is more frequently met with upon the heads of neglected, ill-nourished children, than elsewhere, there is little doubt that any one of these spores of the *achorion schönleinii*, as the fungous cause is denominated, might, under favorable circumstances, germinate and give rise to an abundant crop of favus in the hair, beard, or skin of the most vigorous individual upon whom they happened to be deposited.

Dr. White, of Boston, states that his observation teaches him that favus affects perfectly healthy skins, belonging to perfectly bodies; that no predisposition or cutaneous idiosyncrasy is essential to its development; and that, although a dirty or a wounded epidermis is favorable to the attachment of the *achorion*, it is not absolutely requisite. He also records,



among others, an instructive case, illustrating the fact that a long time may sometimes elapse between inoculation and development of the characteristic appearances. A few years ago, says he, I saw a poor girl fifteen years old, of a consumptive family, who had had favus for seven years. She had always kept her head well wrapped up, and washed the bandages herself. She subsequently died of consumption, without having pursued any proper course of treatment for the favus. Three years before I first saw this patient, her little cousin, eight years old, had on one occasion put on her bonnet while the favus disease was in a very active condition. About a month afterwards a little pimple was observed on the crown of this child's head; and this pimple, which looked white and scaly, disappeared for a week or two at a time, after washing the head, but always returned. One year after the death of her cousin, this child, then, of course, twelve years old, was brought to me with a large, well-marked mass of favus, situated upon the seat of the persistent pimple.

In some cases the fungus of favus attacks the nails, developing beneath them and by the pressure which it causes producing their absorption and perforation. Much local inflammation about the root of the nail is thus set up.

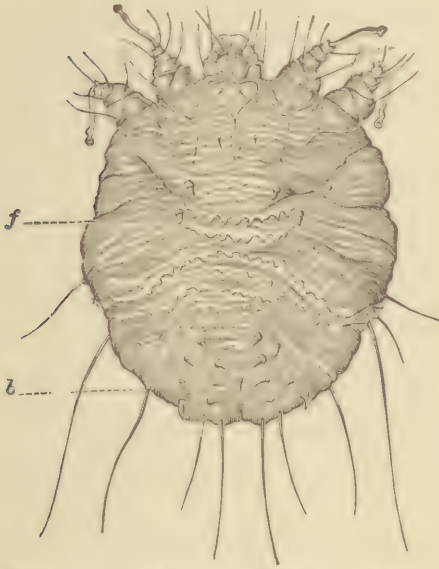
*Treatment.*—The treatment of favus consists in removing the crusts by softening with a poultice, cutting or shaving off the hair, and then rubbing in thoroughly sulphur or tar ointment. If the spot is small a weak solution of corrosive sublimate may be painted over it, but this powerful poison requires very careful management. In obstinate cases it may be necessary to pull out the hair, either by the process of avulsion, where a cap made of adhesive plaster is suddenly torn off the head, bringing the hair with it, or by extracting six or eight hairs at a time with tweezers. This latter operation, called epilation, is denominated by Sir E. Wilson "the purgatory of avulsion," and condemned as little less cruel.

*TINEA VERSICOLOR* or *CHLOASMA* depends on the growth in the epidermis of a fungus similar to that of ring-worm, but bearing its spores in heaps like bunches of grapes. The disease, which is seldom troublesome, is characterized by brownish-yellow, slightly scaly, irregular patches, which appear on the front of the chest and sides of the neck. It may also affect other parts of the body. As it does not penetrate deeply into the epidermis it is easily cured by painting with tincture of iodine, tincture of chloride of iron, or solution of sulphurous acid.

*SCABIES* or *THE ITCH*, the most important skin disease caused by an animal parasite, was called in former times, when its true cause was but little understood, the seven-years itch, because it was so hard to cure. At present it is universally admitted that the whole cause of this most annoying malady is the itch insect, or itch-mite, which is represented in the cut on the following page as it appears under the microscope if magnified about two hundred diameters. From the irritation set up by the parasite, and still more

from the scratching to which it drives the unfortunate patient, vesicles, pimples, and pustules are formed and grouped together in every variety. The itching, which is terribly severe even in daytime, is generally much worse at night after becoming warm in bed. The favorite haunts of the insect upon its human domain are the hollows of the elbows and knees,

FIG. 46.



THE ITCH INSECT MAGNIFIED TWO HUNDRED TIMES.

the front of the wrists, and the backs of the hands just between the roots of the fingers; but it is also found in other portions of the body where the skin is tender. The palms of the hands and the soles of the feet are not infrequently infested, notwithstanding the integument is thick in these parts. In a vast majority of cases showing discrete or separate eruption on the palms and soles it is due to either scabies or syphilis, and the presence of itching in the former and its absence in the latter of these two diseases enables us to distinguish them with great certainty. The accompanying eruptions of scabies vary somewhat in their character according to situation. Thus the prurigo of itch is generally best

defined upon the forearms, the lower part of the abdomen, and the upper and inner portion of the thighs. A vesicular eruption is more frequent about the fingers and breast of thin-skinned people, and pustules are met with in children especially on the hands, feet, and hips. In searching for a specimen of the insect, which can be seen quite distinctly with a good magnifying glass, it is well to look for one of the pimples, which has, extending from it, a little whitish line about the eighth of an inch long and generally somewhat curved. This is the burrow of the female insect, in which she has laid her eggs, and is raising a happy little family to follow her example and live off of the fat of the land they inhabit. If the top of the burrow is scratched through very carefully at its outer end with the point of a fine needle and then the tiny round dot which may be found there picked out on the needle and transferred to a slip of glass, positive evidence of the nature of the disease can be at once detected by suitable examination under a microscope or hand-magnifier.

The figure on the next page represents one of these burrows of the acarus scabies or itch insect, and in it is seen the mother of the family at the upper extremity, whilst eggs and young in various stages of development

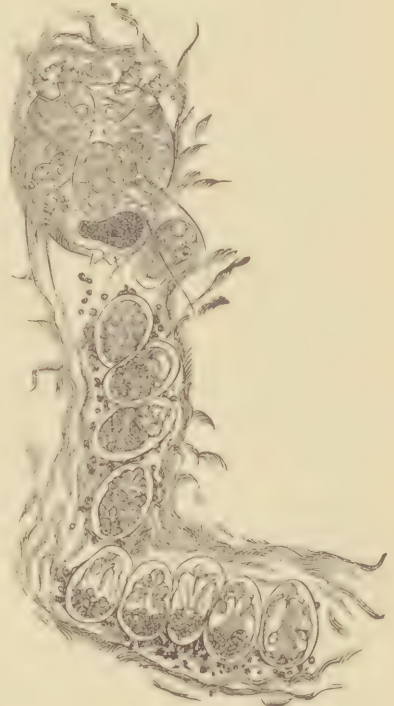
are depicted in different portions of the gallery excavated for their accommodation in the epidermis of their hospitable host.

*Treatment.*—The treatment of scabies should be by applications which, whilst they tend to kill the insects, will increase as little as possible the irritation of the skin. If this irritation is not already too great, the patient should go into a warm bath and scrub himself with brown or soft soap for half an hour, he should then lie in the bath for another half hour, and after being thoroughly dried, rub himself with the compound sulphur ointment all over, except the head, for twenty minutes, allowing the ointment to remain on the body all night. This whole process should be repeated every night for three times, which will probably end the lives of the itch insects, and so terminate the malady. In order, however, to avoid being re-infected from the clothing upon which some of acari or their eggs may remain, every article that will bear washing should be thoroughly boiled, and those pieces of apparel which would be injured by water should be several times pressed with a hot iron, so as to completely destroy the parasites. When the skin is very irritable the application of peruvian balsam or the styrax ointment should be tried at first, and it ought to be remembered that even in those whose skins are not remarkably tender

the sulphur ointment if used very vigorously is apt to produce an eczematous eruption, which, however, quickly subsides on the cessation of the application.

The three kinds of pediculi or lice which infest the head, the body and the pubes of man, differ in their appearance under the microscope, being apparently each best fitted for the special part it has to play in tormenting the human family. They can all be defeated in this great business of their lives by strict attention to cleanliness, frequent bathing, and the application of mercurial ointment diluted with five times its bulk of lard. For the purpose of avoiding salivation, this ointment should not be used directly after a bath, nor rubbed in very strongly, nor, in fact, allowed to remain in contact with the skin any more than necessary.

FIG. 47.



THE BURROW OF THE ITCH INSECT.



## CHAPTER XV.

### DISEASES OF THE BONES AND MUSCLES.

THE bones make up the framework of the human body, and some of them correspond very nearly to the beams and rafters of a house preserving the shape of the building, and giving the whole edifice strength and solidity in all its parts. Other bones, which help to constitute the moveable portions of the frame, are more like the rods and levers of a locomotive or mowing-machine, as for instance the bones of the legs, which have been already compared to the walking-beams of a steam-engine.

The entire number of the bones, not counting the teeth, varies a little at different ages, but is usually given at two hundred and six, if the two knee-pans are included in the enumeration. Of this number twenty-six are found in the backbone or spine; twenty-two in the skull and face; the ribs count twenty-four, twelve on each side, whether the person be man or woman; each arm has thirty-two bones, and each leg has thirty. These bones vary very much in size, shape, and thickness, and all have been named and described with great minuteness by anatomists.

A good idea of the structure of a bone may be gained by picking the second joint of a chicken or turkey clean, and then sawing off about an inch of the upper end and splitting this piece in half lengthwise with a hatchet or strong knife. This thigh-bone of a turkey corresponds to the femur or thigh-bone in a human being, where it lies near the centre of the leg and reaches from the hip to the knee. Its upper end may be recognized by its having upon it a single round knob, which formed part of the hip-joint.

On examining such a bone it is found to be hollow in the middle, and partly filled with a fatty substance called the marrow of bone. In this marrow run important little blood-vessels, which carry the blood to nourish the bone, and from it they pass and repass to minute channels running lengthwise in its substance, which are called the Haversian canals, after the name of the physician who first discovered them. In dried bones, and especially when they have undergone prolonged bleaching in the open air, such as those of a long dead horse or cow, these Haversian canals may be readily seen, looking like fine pores in the broken ends of



*Parts of the Human Skeleton*





the bones. Under the microscope they are discovered to be encircled with rings of lacuna, or little holes in the bone substance, each of which communicates with its neighbors by very minute branching tubes. During the life of an animal the lacuna are filled with soft, jelly-like bone-corpuscles, but in dried bones these gelatinous bodies shrivel up, leaving the lacuna empty, except of air, which, by refracting light differently from what the solid bone does, makes the lacuna look like black dots under the microscope.

If the breast-bone of a young chicken is examined it will be found that its smaller end is made up of the tough, milk-white or semi-transparent substance, called gristle or cartilage. When a chicken is first hatched nearly all its bones are chiefly composed of cartilage, and as it grows older they gradually become more and more ossified, that is, changed into bone. But certain portions of the body commonly remain cartilaginous through life, as, for instance, the grisly bands which fasten the ribs to the breast-bone, and the rings of the trachea or wind-pipe.

The bones of the arm, counting from the shoulder downward as it hangs at the side, are first the humerus or arm-bone, which extends to the elbow, and next the two bones of the fore-arm, which make up the part from the elbow to the wrist, and are named the radius and ulna. The latter of these two bones projects on the under side of the arm, and the radius has the hand attached to it, and is rolled part way around the ulna every time the hand is turned over from the position of pronation, or lying with its palm downwards, to that of supination or lying upon its back. This is a very important movement, and great care must be taken by the use of properly padded splints to save it, when the radius and ulna of the fore-arm are fractured by accident, as very frequently happens.

The wrist or carpus is composed of eight small bones, each with a hard name derived from Greek or Latin, and the palm of the hand is formed by four of the metacarpal, a word meaning beyond the wrist bones, the metacarpal bone of the thumb making the fifth. The bones of the fingers consist of three rows of phalanges, the thumb having two phalanges only.

Beside the bones mentioned, anatomists reckon the shoulder-blade, or scapula, and the collar-bone, or clavicle, as belonging to the arm, or, as they name it, the upper extremity.

The joints of the arm exemplify the two chief kinds of articulations made use of in the human body, namely the ball and socket joint, of which the shoulder is an example, and the hinge-like joint, of which the elbow is a good illustration. The joints between the metacarpal bones and the first row of the phalanges of the fingers, that is, those at the roots of the fingers, are imperfectly formed ball and socket joints, and allow, as anyone can see in his own hands, of a good deal of lateral or sidewise, as well as backward and forward, motion. The other articulations of the fingers are hinge-joints, and, like the hinges of a gate, permit only of a back and forth motion.

The ends of bones where they rub against each other inside the joints are covered with firm smooth cartilage, and to diminish the friction as much as possible these polished surfaces of cartilage are kept slippery by a peculiar liquid named the synovial fluid or "joint-water." This synovial fluid, called also the synovia, acts the part of oil to a door-hinge, and when sometimes in old people the synovia becomes scanty, their joints will creak and grow stiff, just as the hinges of a door do for want of oil. The ends of the bones in a joint are held in place by a tough, firm wrapper, called the capsular ligament, which encloses them tightly on all sides, and also prevents the synovia from escaping and being lost.

In general arrangement the bones of the legs are very similar to those of the arms, making allowance for the difference in function of the two pairs of limbs. The thigh-bone or femur is the longest and strongest bone in the body, as might be expected from the larger share of work in walking, running, and leaping, it has to perform. It is articulated (or jointed) to the pelvis at the lower corner of the body by the hip-joint, a ball and socket articulation, which allows of considerable movement in every direction.

From the knee to the ankle, the leg, like the fore-arm, is furnished with two bones. One of these, called the tibia, is the shin-bone, forming the front of the leg and the inner side of the ankle, that is, the side next the other limb. The bone on the outer side of each leg and each ankle is named the fibula, and is much smaller than the tibia, its partner in the business of supporting the weight of the body. The ankle or tarsus is composed of seven bones instead of eight, as are found in the carpus, and it is articulated below and in front, near the middle of the foot, with the five metatarsal bones. At the front ends of the metatarsal bones are jointed on the toes, each with its three rows of phalanges, except the great toe, which, like the thumb, has but two.

The ankle-joint is more apt to be "sprained" or "strained," than any other, and this accident, therefore, requires a few words of explanation here. A strain of a joint is the result of moving the bones which compose it too far, or in an unnatural direction, so that the capsular and other ligaments are stretched or perhaps torn a little by the force applied. A strained joint is very painful, apt to swell rapidly, and often proves troublesome for months, or even years, if not properly treated. Until a doctor comes, the injured articulation should be placed in an elevated position, so that the blood will drain away from it, kept perfectly quiet, and covered with cloths wrung out of cold water, so as to reduce the danger of inflammation.

The bones of the skull or cranium are broad, comparatively thin, and curved in such a way as to make a hollow case or oval box, shaped a good deal like an egg, for the protection of the brain, which is placed inside of them. The most important are the frontal or forehead bone,



the two temporal or temple bones, and the occipital bone, which is at the back of the head. These bones are united together by seams or sutures, consisting of a curious kind of dove-tailing, which fastens them so firmly together that, in their natural state, it is impossible to get them apart without breaking them. The arched form of the skull makes it much more capable of resisting blows upon the head; but if these are so severe as to fracture the bones, especially if they are dented in so as to press upon the brain, unconsciousness is often very quickly produced. This would happen much more frequently were it not for the layer of spongy matter intersposed between the hard plates which form the cranial bones.

The bones of the face are comparatively light and thin, except the lower jawbone, into which are set the lower teeth, and which is the only bone about the head which is furnished with a movable joint, except the occipital bone, where it rests upon the neck.

The spine or backbone is made up of twenty-four vertebræ, the sacrum and the coccyx. These latter bones seem to be each composed of several vertebræ, which, for the purpose of being rendered stronger, have grown fast together. The uppermost vertebra is called the atlas, because upon it the head is supported; and the second is named the axis, because upon it the atlas, and with it the whole head, turns, as in shaking the head negatively. The upper seven vertebræ are called the cervicæ or neck bones; the next twelve are designated as the dorsal or back vertebræ; and the last five are named the lumbar vertebræ or vertebræ of the loins. These twenty-four bones are fitted together in such a way as to form a continuous tube, which receives and protects the spinal cord or spinal marrow just as the upper continuation of the spinal cord—that is, the brain—is encased and protected by the bones of the skull. The vertebræ are jointed so as to allow considerable motion, both sideways, forwards, and backwards, and have between each pair a cushion of fibro-cartilage, which serves to preserve the brain from injury by the shocks and jars which would otherwise be given to it in jumping, running, and various other movements. The sacrum, which is continuous with the vertebræ, is united with two large, flat, and irregularly-shaped bones, to form the pelvis or basin at the lower part of the trunk. The pelvis supports the spine and the organs in the abdominal cavity, and is in its turn sustained on each side by the thigh bones, which prop it up at the hip-joints, as already indicated.

The heart and lungs are protected by a bony cage composed of the twenty-four ribs, which lie a little beneath the skin of the thorax or chest and in thin persons can be easily felt at the sides or near the breast bone. This breast bone or sternum is situated directly in the middle or front of the thorax, and has the front ends of the ribs attached to it by cartilages, named the costal or rib-cartilages, which allow of the outward and upward movement of the ribs, necessary in breathing. The back or posterior ends



of the ribs are jointed on to the vertebræ of the spinal column in such a way as to allow of the needful motion, and yet secure sufficient stability and firmness.

When a dislocation occurs, or, as it is commonly called, a bone is put out of joint, the bones composing an articulation have been pulled or twisted so hard as to displace them, breaking some of the ligaments which are arranged to keep them in their proper positions. Generally, a person whose arm, at the shoulder, for example, is dislocated, suffers a good deal of pain and loses the use of the limb until the bones are put back in their places again, or, as it is called, the dislocation is reduced. A dislocation is one of the heavy penalties people often have to pay for imprudent over-exertion in lifting and wrestling, or for carelessly letting themselves have falls and hard knocks, or becoming entangled in railway accidents.

The repair of broken or fractured bones is a wonderful process of nature, in which a soft material called callus, at first like putty, is formed around the broken ends, holding them together, feebly at first, but afterwards, as it gradually hardens, uniting them very firmly indeed. Since this "knitting" of the broken bones may occur in almost any position they happen to lie in, or are pulled into by the irritated muscles in the neighborhood, it is evidently very important that they should be put and kept in exactly the right place. For this purpose, the many ingenious splints and bandages used by surgeons have been devised, as will be pointed out in a subsequent chapter on wounds and accidents.

### THE MUSCULAR SYSTEM.

The power which moves different parts of the frame, according to the directions of the will, as, for instance, the legs, in walking, is produced by the contraction of muscles. These muscles form the lean meat of animals and of the human body, and, except in very fat people, make up a larger portion of the bulk of the frame, than any of its other constituents. They are composed, as is readily seen in a piece of fresh beef or mutton, of long strings of reddish material, which, under the microscope, are found to be made up of a multitude of fine, beaded threads, arranged in small bundles, and called the ultimate muscular fibres. They exercise power in moving the limbs, and so forth, by shortening up or contracting when excited by the nervous fluid, sent to them through the nerves from the brain, as ordered to do so by the will. The exact mechanism of moving the arm, for instance, by the process of contraction, may be easily understood from the picture below (see Fig. 48), in which it is readily perceived that the shortening up of the muscle must pull up the hand, bending the arm at the elbow-joint, and changing the position from that represented in the

second, to that shown in the third figure. Precisely the same kind of operations accomplish the motions of lifting the feet in walking or climbing, swinging the arm in throwing a ball, opening and shutting the mouth, and, indeed, of most of the voluntary movements of which we are capable. But whilst many of the muscles are controlled by the will, and are, therefore, called voluntary, many of them are not so ruled, and hence have received the name of involuntary. Among the most important of the involuntary muscles are the heart, the intercostal muscles, the muscles between the ribs which help to expand the lungs in respiration, and the muscular fibres of the alimentary canal, which aid in pushing along the food in digestion. Fortunate is it for us that such is the fact; for otherwise, when our wills were off duty, as in sound sleep, the operations of these vital organs would stop, and life, which depends upon them, soon cease.

The muscles are usually attached to the bones, and move them, by sinews or tendons, which are made of white, fibrous tissue, the strongest and most flexible material in the body. These tendons are like long, round, white cords, such as may be seen in the lower part of the leg of a chicken. The largest tendon in the human body is that of the heel, called the tendon Achilles, which is the continuation of the big muscle of the calf of the leg. This powerful muscle is used in jumping, and, since it acts at a great disadvantage, is necessarily very strong in order to be able to throw the entire body forward, as in making a leap. As a general, but by no means universal, rule, a muscle has one attachment which is fixed, commonly spoken of as its origin, and a second, called its insertion, upon which it acts by drawing it towards the origin when the muscular substance contracts. Muscles mostly pass in a straight line between their two attachments, but sometimes they act around an angle by sliding over a pulley, or by means of a small bone in the tendon, like the knee-pan. The muscles are so attached that they are always slightly on the stretch, and thus, at the moment they begin to contract, they are in an advantageous position to bring their action to bear on the bones which they move. When the contraction ceases, the bones are drawn back to their former position without any sudden jerk. The muscles commonly act upon the bones as levers, by working upon the short arm of the lever, so that more direct force is required on the part of the muscle than there is weight in the body moved. From this arrangement, however, the indispensable advantage is gained that the small contraction of the muscle causes an extensive movement of the part acted upon, and much greater rapidity of motion is secured. Each of the three orders of levers is met with in the different bones of the human skeleton; often, indeed, all three varieties are found in the same joint, as, for example, the elbow, where the simple flexion and extension of the biceps and triceps muscles, which are large, fleshy masses on the front and back of

the arm, between the shoulder and elbow, afford excellent illustrations, as shown in the accompanying figure.

The arm is used as a lever of the first order when the triceps is caused to contract, and by pulling upon the upper end of the small bone of the fore-arm moves the hand around the elbow-joint, which serves as a fulcrum.

This is shown in the upper diagram in which the hand is represented as striking a blow with a dagger.

Again the arm furnishes an example of a lever of the second order, when the hand resting on a point of support, such as a table, acts as the fulcrum, and the triceps muscle pulling on the upper end of the ulna or smaller arm bone, by straightening the arm lifts a weight placed upon it in front of the elbow.

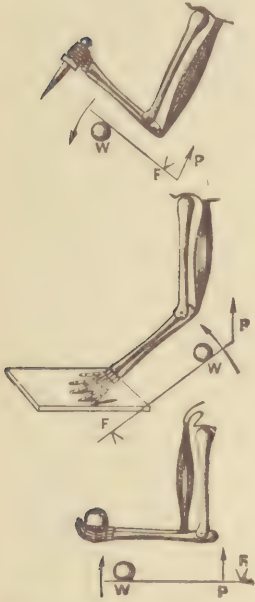
The third order of levers is exemplified by the arm when bent by the contraction of the biceps in ordinary flexion of the elbow. Here the muscle, which is the power, is placed between the fulcrum, which is the lower end of the humerus at the elbow-joint, and the weight, which is lifted in the palm of the hand, as shown in the lower diagram.

The whole number of muscles in the human being is not far from five hundred, mostly arranged in pairs on opposite sides of the head, body, or limbs. It is therefore manifestly impossible to describe them all in detail here, and yet

there are a few which are important enough to require notice. Among the muscles of the face should be mentioned those of the eye, six in number, four of which turn the eye-ball up or down, inward toward the nose or out toward the temple, as becomes necessary to see an object distinctly. The muscles of expression are especially attached about the mouth, and produce their effects by puckering up the lips as in whistling, drawing up the corners and widening the mouth, as in laughing, pulling down its angles, as in weeping, and so forth. The masseter muscles placed inside the cheeks between the upper and lower jaws are very strong, and enable human beings to chew up some very hard articles of food in the operation of mastication, as has been already explained.

The action of the large muscle of the front of the arm, called the biceps or two-headed muscle, has been already described. The muscles of the fore-arm, which shut the fingers as in clasping the hand, are called the flexors, because they flex or bend the fingers. The tendons by which their power is conveyed may be readily felt on the inside of the wrist of

FIG. 48.



BONES OF THE FOREARM ACTING AS LEVERS OF THE THREE ORDERS.



a man who tries to shut his hand when the fingers are forcibly held open by another person. The fore-arm muscles which open out the fingers after the hand is closed, in doubling up the fist for instance by the flexors, are called the extensors. The tendons of the extensor muscles, when the latter are strongly contracted, show very distinctly on the back of the hand, as straight, hard cords, running from the root of each finger to the middle of the wrist.

The spinal column is almost surrounded, except in front, by a thick mass of muscles, which gives the great strength required by many kinds of laborers, such as porters who carry heavy loads upon their backs. The muscles of the legs, which are needed in walking, running, and jumping, are very large and strong, corresponding to the hard work they are called upon to perform. The longest muscle in the body is the sartorius or tailor's muscle, which is so named because it helps to bend the lower limbs into the cross-legged posture so frequently adopted by tailors. It lies on the inside of the thigh, is thin and narrow, but sometimes measures over two feet in length.

The intercostals are flat, thin layers of muscular fibres, which extend from the lower edge of each rib, except the last pair, to the upper margin of the rib next below. In this way they fill up all the spaces between the bars of the bony cage in which the lungs are contained, and, when they contract, pull up these bars or ribs so as to widen and deepen the cavity of the thorax, and so cause air to be drawn into the lungs.

Inflammatory affections of the bones and of their enveloping membrane are occasionally met with, but are much more common as a result of syphilitic or scrofulous disease than as a primary complaint. Their treatment is chiefly therefore that of these two dangerous maladies. Inflammation in bone is attended with great pain, and very gradual swelling of the affected part, and if the process goes on the diseased bone in the centre of the portion involved may die or undergo necrosis, as it is termed, just as local death may occur to connective tissue, which then forms the slough, or core, of a common boil.

Nodes are hard bony swellings, the results of a subacute inflammation not going on to caries or necrosis, which are apt to occur as tertiary symptoms of constitutional syphilis. They are frequently found on the front surface of the tibia or shin-bone, and are often very painful for a time, although yielding to treatment with the iodide of potassium in a majority of cases.

Mollities ossium is an uncommon disease in which there is a deficiency of earthy matter in the bones, so that they become very soft and easily broken by slight accidents. An analogous condition is sometimes found in the insane, and has no doubt given rise unjustly to some of the stories of cruel treatment in asylums for these unfortunates.

The bones are subject to cancer, to cartilaginous or other growths.

Cancer in the osseous structure has received the name of osteoid cancer, and sometimes develops with terrible rapidity. If removed whilst small the operation is to be recommended, on the ground already indicated, but when left until a huge tumor has developed, of the nature of which no doubt can be entertained, any interference is of questionable propriety.

Among the important diseases of the joints must be mentioned synovitis or inflammation of the lining membrane, by which the synovia or joint-water is secreted. This disease, usually attended with severe pain, and when the joint is a large one accompanied with much constitutional disturbance and fever, appears in two forms, the acute and the chronic. The acute form is usually the result of injury, which may be very slight in its character, as even the least puncture of the joint by which the air can enter is liable to produce it. Acute synovitis runs its course in ten or twelve days, causing much swelling and severe suffering on the slightest movement of the limb to which the joint is attached. The chronic form is commonly a continuation of the acute, and may itself result in softening and what is called pulpy degeneration of the synovial membrane. The treatment of synovitis is by free leeching of the affected part; perfect rest in bed, with the limb elevated and secured in a splint if needful; low diet with saline purgatives, such as Epsom salts or Seidlitz powders, and anodynes to relieve pain. In the chronic form small blisters and painting with tincture of iodine are likely to prove useful. Inflammation of the synovial structure of the joints is apt to take on a rheumatic, scrofulous, or syphilitic character in persons who are constitutionally under the influence of these taints. In such instances the appropriate treatment for them, as already pointed out, is to be associated with that for ordinary synovitis.

Ulceration of the cartilages may occur in a joint as a consequence of long continued inflammation, causing intense pain, and usually disabling the limb. Its liability to occur renders the prompt treatment of synovitis doubly important.

Abscess within a joint is rare in healthy persons, but in the scrofulous it is by no means uncommon, and in strumous children abscess in the hip-joint, causing the lamentably frequent affection, coxalgia, is a malady of much importance. The general treatment in these sad cases is that already indicated for scrofula on page 397, but the local trouble should be immediately attended to by an experienced surgeon, and remedied as far as possible by the aid of the complicated apparatus devised for the purpose.

## DISEASES OF THE MUSCLES.

Inflammatory disease of the muscular system, except as it is connected with rheumatism or pyæmia, is extremely uncommon. When it occurs

it is liable to go on to suppuration, and the formation of abscess. The pain is dull and aching rather than acute, and the disease is to be treated as already directed in speaking of the management of boils.

Hypertrophy and atrophy occur in muscles and produce effects important or otherwise, according to the position of the muscle in the animal economy. The most important hypertrophy is that of the muscle composing the heart, the influence of which has been detailed in the article on valvular disease affecting this organ.

Palsy and spasm in various forms have also been considered in the chapter on diseases of the nervous system, upon which these disturbances chiefly, though not entirely, depend.

The most important disease of the muscular system not yet discussed is its infection with parasites, and particularly with the *trichina spiralis* or pork worm, which, in consequence of the late embargoes upon American hams and bacon, has assumed a national or, indeed, an international importance. The great fatality in many cases of trichiniasis, as the malady produced by the *trichina* has been named, and the ease with which the whole trouble can be avoided by a proper understanding of the nature and origin of the affection, render a full account of the entire malady and its means of prevention singularly appropriate to a popular work like the present one.

The *trichina spiralis*, which is next, perhaps, to the *echinococcus*, the most dangerous animal parasite infecting man, is found also in pigs, foxes, guinea-pigs, rats, cats, mice, marmots, polecats, badgers, and more rarely in some other animals, including the dog. A physician of Philadelphia found that of ten cats which he dissected in 1879 nine were infested with *trichinæ*. Pigs, from which the human race is most apt to become diseased with *trichina*, are supposed to become themselves infected, chiefly from eating rats, the offal of other pigs, and the excreta of human beings containing *trichinæ*. It is doubtful whether a single case of trichiniasis in man ever occurred where the patients became infected otherwise than by eating raw or underdone pork, and the most common sources of infection are sausages, ham, and bacon. If the *trichinæ* existing in diseased pork are very young they may be simply digested, when they reach the human stomach, without being developed. But if the parasites have attained their fuller growth, the cysts which contain them are alone dissolved by the gastric juice, and the embryo is set free. These embryos, after they pass through the pylorus and duodenum, soon become mature, and their thread-like

FIG. 49.

TRICHINA SPIRALIS IN  
HUMAN MUSCLES.



appearance renders them quite easily recognizable by the naked eye. Countless eggs are now discharged by the females, and in about a week's time the new brood of trichinæ hatched out from these eggs begin to make their way to the muscles, either by boring their way through the soft tissues, or by being carried along by the current of blood in the blood-vessels, or perhaps by both of these methods of progression through the body. These larval trichinæ attain their full size in about two weeks from the time they leave the egg. The males and females are each about one-thirtieth of an inch long and about one seven-hundredth of an inch broad. In some few favorable cases severe gastro-intestinal inflammation is set up, and the parasites are violently expelled by diarrhœa, without being able to enter the muscles at all, so that if it were possible to detect the malady with certainty at this stage, nature thus suggests the appropriate treatment by drastic purgatives. In the majority of instances, however, the migration of immense numbers of larval trichinæ from the intestinal canal takes place, and occupies in general about four days only. In this brief space of time even the most distant muscles of the body may all be invaded.

FIG. 50.



ENCYSTED TRICHINA MORE HIGHLY MAGNIFIED  
SHOWING STRUCTURE OF THE PARASITES.

Among the earlier symptoms of the trichina disease are a general feeling of debility and discomfort, and a loss of appetite, to which succeed nausea and vomiting, diarrhœa, prostration of strength, and a sensation of stiffness about the neck, arms, and legs. These evidences of illness resemble, it will be observed, to a great extent the first stage of typhoid fever, for which the cases are usually mistaken if there is no point in the history of the patient to suggest trichiniasis. The further progress of the

parasites through the tissues sets up high fever, with frequent pulse and copious offensive perspirations, although the temperature of the body seldom or never reaches the elevation which characterizes that of typhoid. For some days the stiffness of the limbs seems to increase, while all the muscles become painful, swollen, and very sensitive to the touch. About the end of the first week the attention of the attending physician is usually awakened (if it has not previously been aroused) to a suspicion

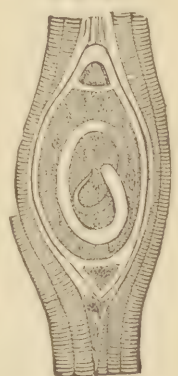
of the trichina disease by the appearance of an œdematous swelling of the eyelids, and root of the nose. This is often the first characteristic sign of trichiniasis, and should be looked for at this period of the illness in all cases of supposed typhoid and rheumatic fever. During the second week movement of the intercostal muscles in respiration grows very painful, thus preventing to a great extent the necessary repose of the patient. If the diaphragm is invaded, trouble hiccough is apt to come on, and when the larval trichinæ commence to infest the laryngeal muscles hoarseness and loss of voice make their appearance.

When a large quantity of trichinous meat has been eaten, so that the immigration into the muscles of the afflicted patient is by millions, they soon cause an almost paralyzed condition, attended by excessive exhaustion. The facial œdema continues through the second week, when it generally disappears, and is followed by swelling of the feet and legs, and ultimately of the trunk. At the end of the third week, if the patient survives to this period, the pulse and respiration are very frequent, the tongue is red and dry, the mouth can scarcely be opened, the sweating is profuse, the pain so severe that little or no sleep can be obtained, and there is great anxiety or delirium, death frequently occurring in the fourth or fifth week, with symptoms of profound exhaustion. Complications, such as pneumonia, peritonitis, and pleurisy, are not uncommon, but in favorable cases when the number of trichinæ is comparatively small, or the constitution of the patient unusually vigorous, the pain, swelling, and diarrhœa begin to abate, the oppression of breathing passes off, the desire for food returns, sleep is obtained, and the anæmic patient enters upon a slow and tedious convalescence; the parasites having become encysted within the muscles, these gradually become acclimated, as it were, to the presence of the foreign bodies, and slowly regain most or all of their original powers and functions.

After piercing the fibrous sheath of the muscular fibre bundles, the embryonic trichinæ become encysted within lemon-shaped capsules (generally only one worm in each capsule), of a sort of connective tissue, in which they have some freedom of movement. After a time, these capsules, which, of course, are fixed to one spot in the muscle, become calcified, a process which occupies in man about two years. During this period there is often, for a time, in patients who recover, some loss of power, for a while almost complete, in muscles or groups of muscles; but not infrequently, after this stage is reached, entire recovery ultimately seems to take place.

Still, this infested condition of the muscles, which probably exists in thousands of people who walk about utterly unconscious of it,

FIG. 51.



COMMENCING CALCIFICATION OF TRICHINA CYST.



may be the yet undetermined cause of rheumatism and paralysis, or promote the development of consumption, and other wasting diseases.

The mature trichinæ—the males being about one-eighteenth and the females about one-eighth of an inch long—live in the intestines for six or eight weeks. They never reach the soft tissues of the body, in which their young larvæ are so abundant, but are discharged, from time to time, with the excreta of the patient, either alive or after their death has occurred.



FIG. 52.  
TRICHINA AND ITS CYST  
COMPLETELY CALCIFIED.

Trichinæ, as well as cysticerci, were first discovered in human beings in the dissecting room, by Dr. Simon, in 1835. Professor Owen first described and named the trichinæ, and Professor Leidy was the first to detect them in the pig. They were, however, repeatedly observed without their true import being ascertained until 1860, when Dr. Zenker, of Dresden, explained their origin and relation to certain symptoms of obscure attacks of sickness, and described the disease trichinosis or trichiniasis. In the same year, Leukart published his elaborate and trustworthy investigations upon the subject of the trichina. Previous to 1860,

the trichina had been identified only once in pork, although, as occurring in man, it had been well known for a quarter of a century. It is not decided how it they will retain its vitality when encysted in human muscles. Professor Langenbeck, of Berlin, has reported a case where, in removing a tumor from the neck of a patient, eighteen years after the man had an attack of trichiniasis, which passed for poisoning at the time, he found living trichinæ in the fragments of attached muscles: and it is stated on good authority that they have been known to exhibit signs of life after a still greater lapse of time. As in this instance, before Zenker's discovery, very many cases passed for poisoning, for typhoid and rheumatic fever, and for other diseases. An epidemic involving over five hundred persons, in Blankenberg, Germany, was treated as an outbreak of gastro-rheumatic fever, and it was only several years afterwards that the attention of one of the gentlemen who suffered from the disease being called to Zenker's discovery, he submitted to an operation for the removal of a small piece of one of his pectoral muscles, in which encysted trichinæ were detected, and the true nature of the disorder which had affected the five hundred patients many years previously, was revealed for the first time.

In this country, severe epidemics have occurred in New York, Mississippi, and Iowa, and isolated cases are from time to time appearing in various other States. In 1875, it is stated, that there were some eighty cases of trichiniasis in Berlin, and about seventy-five near Hanover. A



group of cases occurred in 1882 in Bridesburg, and another near New York. In 1874 there was quite a severe epidemic in the family of a pork packer residing in Buffalo, New York. The disease is as rare in France as it is common throughout the German empire.

In pork the trichina may be found either encysted or naked among the muscular fibres. It is not certain how long they may live after the pig is killed, but they are known to be capable of propagation after remaining for one hundred days in putrid pork. The frequency of the disease in swine is probably as great, if not greater, in America than elsewhere; but here mankind is not so often infected, because less raw or under-done sausage, ham, bacon, and so forth, is eaten with us than in Europe. Of 1,394 hogs taken at random, and examined by the Chicago Academy of Sciences, twenty-eight were found to be infected with trichinae; but this large proportion can only be accounted for on the supposition that an epidemic among swine was then raging.

The editor of the *American Journal of Microscopy* recommends that in examining the flesh of swine suspected of being infected with trichinae, the following method should be adopted: The parts of the animal to be first tested are the diaphragm, the tenderloin, and the muscles of the head and throat. In the ham, the most likely place to find the parasites is where the muscle ends in tendon. A thin slice should be cut off with a sharp scalpel, or with a pair of scissors curved on the flat. This thin section should then be soaked for some minutes in acetic acid, spread out on a glass slide, and covered with a thin glass in the ordinary way; or, if the section happens to be very thick, a compressorium, in which the two plates of glass are forced together by means of a lever and screw, will be found very useful.

A little instrument constructed on the plan of the compressorium, and called a "trichinoscope," is sold to supply the popular demand for home protection against trichinae.

Since trichinous pork can only be discovered, as a rule, by the microscope—unless the capsules have undergone at least partial calcareous degeneration—it has been strongly urged that government inspection should be rigorously enforced here in America, wherever pork is sold. Pappenheim thinks, very correctly, however, that a system of this kind in thinly-settled countries, as our own is in many localities, would be impracticable, and that the only security lies in diffusing information among the people. Dr. Germer, Health Officer of Erie, Pennsylvania, is reported to have instructed the pupils in the public schools respecting the natural history and microscopic appearances of the trichina; and it would be

FIG. 53.



HUMAN MUSCLE CONTAINING CALCIFIED TRICHINÆ.  
(Natural size.)

well if his example were generally followed in educational establishments. All pork which has been found to contain trichinae, should be seized, condemned, and destroyed, either by fire or by strong mineral acids, such as the sulphuric or nitric. Mere burying of poisonous meat of this kind is obviously not sufficient. Moreover, the question as to whether owners of such carcasses should not be compensated for all property confiscated, is well worthy of consideration ; because, if such was the rule, butchers and dealers would have no inducement for concealment and fraudulent sales. In spite, however, of any apparently perfect system of inspection, such as that adopted in Germany, dangerous meat, from some cause or other, will necessarily escape observation ; so that the only safe rule for us to adopt, and to urge upon everybody else, is *never to eat any pork* which has not been *thoroughly cooked*. It is not safe to trust to pickling and smoking, even when these processes are combined, as is ordinarily the case, and it must be borne in mind that meat is seldom thoroughly cooked when cut in slices more than an inch thick. The fact that two dangerous and often fatal maladies like trichinosis and cysticercus disease, both of which are generally beyond the reach of medical treatment when once they have infected a human system, are not infrequent from eating pork which has been imperfectly cooked, should render the employment of this culinary precaution in regard to all meats universal, especially as it is a safeguard so easily applied.

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## CHAPTER XVI.

# WOUNDS AND ACCIDENTS.

WOUNDS are injuries in which the skin has been torn or divided, and comprise cuts, stabs, gun-shot wounds, bruised wounds, and so forth. The danger of a wound depends upon its depth and size, and above all upon the importance of the underlying parts involved, such as arteries and nerves, or vital organs, such as the heart and lungs. Stabs and gun-shot wounds are generally far more dangerous than would appear from their size, because they are apt to involve vital portions of the frame, and also because pieces of the weapon or of the bullet may be left remaining in the wound, as was the case with the lamented President Garfield a few years since.

The healing of wounds occurs in two ways. In the first place a wound may heal by primary union, or, as it is also called, union by the first intention, without the formation of any pus or matter, and leaving only a very fine line-like scar. This mode of healing should always be sought for, but can seldom be obtained, except under the following conditions, to wit;—when the sides of the wound can be accurately fitted together, and are not subsequently displaced by bleeding or the exudation of matter, also when the wound is left quiet and protected from outward injury, and when it is kept free from impurity. The second mode of healing takes place slowly, with suppuration and the formation of little rounded knobs, called granulations, all over the raw surface, and leaves a large, red scar, ultimately becoming dead white. This second and far inferior method of healing is observed when the favorable conditions just mentioned are absent, as for example, first, when so much of the skin has been destroyed that the edges of a wound cannot be brought together, as in wounds caused by cannon balls or shells, in scalp wounds from blunt instruments, or where the edges of wounds are so torn and bruised that their life is crushed out; second, where the edges of wounds are separated after they were adjusted, by blood being effused, or by the formation of pus. Third, when the injured parts have been disturbed, as, for instance, in the leg, by standing or walking, or the hand and arm by working, and so forth; or, if the wounded party has been badly transported from the scene of the accident; or, lastly, when the wound was dirty and had not been properly cleansed or disinfected, because want of cleanliness leads directly to putrefaction and the formation of pus, and it is especially the matter formed in the process of suppuration which separates the sides of wounds and prevents their healing by the first intention. When the wound does begin to heal in the second and inferior method, granulations form, which are often called proud flesh, and are especially dreaded by ignorant persons as dangerous intruders into a sore. These granulations by degrees organize into a living tissue of great firmness, and after they have filled up the cavity of the wound to the level of the surrounding cutaneous surface, or sometimes a little above it, they cover themselves with a sort of epidermis and constitute a scar.

Suppuration and putrefaction open the door to sundry other dangerous diseases, of which many people die after wounds and operations, especially in hospitals. Amongst these dangers are fever, hospital gangrene, erysipelas, and pyæmia, which have already been described, with their appropriate treatment.

The method of treating a wound, therefore, is, if there is a reasonable chance of securing its healing by the first intention, to seek primarily for that advantageous result which saves so much time, trouble, and suffering to the patient. For this purpose, if it can be done, all bleeding must be stopped before the wound is closed. This is generally done by



tying all the arteries which have been cut in the wound. Waxed sewing silk is generally employed for tying arteries, although better results are reported from the use of carbolized catgut, which dissolves in the wound. The usual method of tying an artery is to pick it up with a sharp hook, a hair-pin or large needle bent in a candle-flame might do if nothing better could be had, and then tie a silk thread tightly around the little bunch of flesh in which the blood-vessel is included. After the hemorrhage is entirely stopped, the edges of the wound are brought together with stitches of waxed silk or lead wire, and supported in that position with strips of sticking-plaster, or preferably with a bandage, if it can be securely applied. Then the injured part must be left perfectly quiet and undisturbed until the process of healing is complete. On this account, if everything goes on well, the bandage ought not to be removed for several days, or until the injury is nearly healed. Even after the bandage is taken off, the wounded limb must be moved as little as possible for a few days longer, lest the wound open afresh and matter be caused to form in it after all.

The fact that hemorrhage may readily prove fatal, or, as it is popularly phrased, the person may easily bleed to death, is so important that a more detailed explanation is needful. Every wound bleeds because, as already mentioned, in every wound blood-vessels are injured. But the kind of hemorrhage, as well as its danger, varies with the size and the nature of the blood-vessels which have been divided. If the blood does not flow freely, but trickles from the wound, one may conclude that only small blood-vessels have been severed. When dark blood wells out in a steady stream, and when the flow is increased by pressure above the injured spot, that is, nearer the heart of the patient, a large vein has been opened. Lastly, when bright, red jets spurt out of the wound, forcibly, and in jerks, an artery is divided and danger to life is great and immediate.

Unimportant hemorrhages from very minute arteries, and from veins of only moderate size, can generally be arrested by pressure upon the wound itself, or by pressing the sides of the cut against each other, or it may stop of its own accord in consequence of the mouths of the vessels contracting and the blood in the wound coagulating into a tough, viscid mass.

Hemorrhage from an injured vein, as, for example, that from the giving way of a varicose vein in the leg, is sometimes difficult to check, on account of the pressure of some light article of clothing, such as a garter, above the bleeding point. On loosening this, slight pressure and elevation of the foot above the level of the hip suffice to arrest the bleeding.

If, however, bright, red blood continues to flow, in spite of pressure over the wound, a large artery must have been injured, and speedy death from loss of blood must be apprehended. In such instances, prompt aid

is necessary, and a physician or surgeon should at once be sent for. Until he arrives any intelligent person can probably succeed in checking the flow of blood by making very firm pressure on the wound itself, if it is small, or on the trunk of the artery above the wound. The injured limb should be raised, as this lessens the force of the pulse in it, and, of course, the violence of the flow of blood. After cutting the clothing away from the source of hemorrhage, a folded piece of linen, or a pocket-handkerchief, should be laid on the wound, and fastened firmly down by means of a bandage or another handkerchief. But if, in spite of this, the blood still continues to run, the trunk of the artery between the heart and the wound must be sought for and firmly compressed by the fingers, the handle of a large key, or some other suitable object. In certain parts of the body the arteries lie so near the surface that they can be effectually compressed with the fingers. In the upper part of the arm the main artery courses along the inner side, nearly in a line with the inner seam of the coat or dress sleeve, as is shown in the accompanying figure. By

feeling along the place indicated with a dotted line, in any spare person, it is easy to discover the strong pulsation of this large artery of the arm, or brachial artery, as it is technically called. The artery may be compressed in this position by placing a thick stick between the arm and the chest, and tying the arm tightly to the body, or by pressing the artery firmly against the bone of the arm with the thumb, as shown in the illustration. Sometimes, when the wound is higher up on the arm, or in the arm-pit itself, it may be necessary to compress the artery at a point nearer the heart; and this can usually be accomplished by making pressure with the thumb or a big key, just behind the collar-bone, as is also indicated. Unfortunately, at this point large nerves lie so near the artery that any firm pressure upon it is apt to give rise to intense pain, which soon becomes almost unendurable. If it is found difficult to continue the application of force in these situations, or if the only person present must leave the sufferer whilst he hurries off for assistance, the little device known by the name of the Spanish windlass should be resorted to. To apply this, take a large handkerchief, and fold up in it a round pebble about an inch in diameter, or any other smooth, hard body of similar size; fold the handkerchief cravat-shape, and tie it loosely about the limb, at the point where pressure is to be made upon the artery; and then, putting a stout stick beneath the loop, twist it around so as to tighten the

FIG. 54.



DIAGRAM OF MAIN ARTERY OF THE ARM.

handkerchief and bring a strong pressure upon the stone underneath the loop on the side opposite to the stick, which in its turn compresses the artery and stops the flow of blood. This is, of course, a much more painful, as it is a more powerful, method than pressure by a bystander's thumb or finger: but in urgent cases it may be needful to call it into service in order to save life. The Spanish windlass is a rough imitation of the surgical instrument called a tourniquet, which is far preferable as a means of arresting hemorrhage whenever it can be procured. As soon as a tourniquet can be obtained, it should be substituted for the primitive and painful windlass, which, if continued several hours upon a limb, might itself lead to mortification of the part, and perhaps to a fatal result.

In order to check bleeding from wounds in the arm below the elbow, or about the hand, where workmen of all kinds are particularly apt to receive injuries, take a large handkerchief, as before, and tie up in it a stone or a potato of the size of a walnut, or a simple, large, hard knot will perhaps answer the purpose. Then fasten it loosely about the arm, just above the elbow, as shown in the illustration, and bend up the forearm so as to make the knot press upon the large artery in its position in the hollow of the elbow, as indicated in the accompanying wood-cut.

FIG. 55.



METHOD OF CHECKING HEMOR-  
RHAGE IN THE HAND OR  
WRIST.

If the hemorrhage is found to be checked, the knot is in the right place at the bend of the elbow; but if blood continues to flow, straighten the arm, move the knot or stone a little, and try it again. As soon as you find the flow of the blood is stopped, take another large handkerchief, or a strip of bandage, and fasten the wrist firmly to the shoulder, so as to keep up the life-saving pressure upon the blood-vessel at the elbow.

Hemorrhage from wounds of the leg, below the knee, or of the foot, such as are so often inflicted by the slipping of an axe or hatchet in chopping wood, may be controlled in a very similar way by tying a larger pebble in a handkerchief, so as to make a knot the size of a turkey's egg, fitting it in the hollow of the knee, and then bending the leg up on the thigh in such a manner as to produce pressure upon the artery, on exactly the same principle as that displayed in the figure just above. When it is found that the knot is properly adjusted, so as to answer the purpose of arresting the flow of blood, the leg should be secured in its doubled-up position in order to prevent a return of the hemorrhage, in consequence of the apparatus becoming displaced.

For bleeding from wounds in the thigh the artery must be compressed an inch or two below the middle of the groin, and about as far in front of the usual position of the inner seam of the pantaloons, the exact point



being indicated by the marginal illustration, which shows very well the way in which the thumbs ought to be applied in endeavoring to arrest hemorrhage in this manner by pressure. The femoral artery, or artery of the thigh, is so large and strong that its pulsation can usually be felt without much difficulty in thin or even moderately spare persons; and it is a good plan for every one to become acquainted, by examining their own bodies, with the location of this and the other chief arteries, for the purpose of being prepared to render efficient aid, in a case of emergency, to some unfortunate human being who has met with an accident. This point in the femoral artery is also a favorable one for making compression in bleeding wounds of the foot and leg, if from any cause, as, for example, burns or other hurts about the knee, it is impossible or inconvenient to apply the method by pressure behind the knee-joint, as previously suggested.

In whichever way bleeding from an important artery has been for the time checked, it must be remembered that it is very liable to burst out again the moment the pressure is relaxed or the obstruction removed; also, that when a person faints from loss of blood, as even a vigorous man is liable to do at any time after a quart of the vital fluid has escaped, the hemorrhage ceases whilst the heart is beating feebly in the fainting condition, and the blood may clot quite firmly in the mouths of the divided blood-vessels; when the patient revives, however, the renewed vigor of pulsation in the heart and arteries will generally drive out these recently-formed clots of blood, and the bleeding starts afresh with, perhaps, a speedily fatal result, if a most vigilant watch is not maintained over the wound. Where the hemorrhage is venous only, however, there is a good prospect that the clots of blood formed in the open mouths of the vessels will be able to resist the feebler pressure brought to bear upon them by the reviving circulation, and that bleeding will be effectually checked by the occurrence of the fainting fit.

In moving a wounded person from the scene of accident, the chances of recovery are often very much increased by adopting the method involving the least amount of additional injury to parts which have already suffered. The dangers to life from a broken leg, for example, where the skin is not cut through, are more than doubled if, by ignorant handling, with the kindest intentions in the world, the affected limb is allowed to swing downward for a single instant so that some sharp splinter

FIG. 56.



of bone penetrates the skin, and makes the injury a compound fracture. The best method of moving a person who is unable to walk, is upon a stretcher or litter, which may be a light lounge or bedstead, an old-fashioned settee, a long bench, a door or window-shutter slipped off its hinges, or a simple, broad board. Such hard materials should be covered with blankets, quilts, or the coats and so forth of bystanders. In the woods, two poles about ten feet long, kept apart by forked sticks about a foot in length, tied in place with rope, twine or leather straps, or even some climbing plant, and covered with clothing, form a very good litter.

To place the helpless patient upon such a vehicle of transportation, the litter should be set down with its foot at the head of the patient as he lies upon the ground, and in a line with his body. Then, if there is plenty of assistance at hand, let the acting surgeon of the party take charge of the wounded limb, and devote himself, after giving the necessary instructions to an acting assistant surgeon chosen on the instant, to protecting that injured member in every way. Next, let four persons, under direction of the assistant surgeon, lift the sufferer by his hips and shoulders, two others supporting the head and feet, as may be necessary, and when raised to a sufficient height, let two others, still, slide the prepared litter under the patient as he is held up in the air by his seven bearers. He can then be gently deposited upon the litter, having undergone the least amount of disturbance possible under the circumstances. When but few persons are present, this plan of procedure must, of course, be modified; and if the services of only two people are available, it is better, usually, for them to lift the wounded man together, both standing on the same side, one at the shoulders and the other near the hips, and tenderly lay him upon the litter, which has been placed at the opposite side. Another mode, which answers very well when the lower limbs are not injured, is for the two bearers to stand on opposite sides of the patient, and, clasping each others hands beneath his hips and shoulders, carry him a few steps to the litter, which has been arranged with its foot to his head, as directed above, in the first instance. If alone with an individual so severely wounded as to be helpless, the best way often is to make him as comfortable as possible, see that there is no danger of serious bleeding, leave him some weapon to defend himself from biped or quadruped intruders, and hasten for the nearest assistance which can be procured. The litter should be carried by two persons, whilst the acting surgeon walks by the side and keeps a constant watch over the patient. The following rules should be observed: First, the litter should be carried with the hands, or supported by straps passing over the bearers' shoulders. The litter itself should never be placed upon the shoulders of the bearers, because the patient might then fall off, or even die from hemorrhage or other cause without his danger being observed. Second, the bearers should not keep step. If they keep pace, as in marching, the litter sways

from side to side, and the patient is apt to roll about, or even to be thrown to the ground. To prevent this, the bearers must walk in broken step—that is, not putting the right foot, for example, forward at the same moment—and then the litter remains nearly even as it is borne along. Third, the pace of the bearers should be short, not more than twenty inches, and the steps made without any spring on lifting the foot from the ground. The knees should be kept rather bent, and the hips moved as little as possible in walking. All jolting, all hurried movements, and all lifting over fences, ditches, and so forth, are to be avoided. Send some one ahead, if practicable, to look out for gates, bridges, and similar advantages, which are very important in the transportation of the sick and wounded, and let him come back and guide the bearers in the easiest path to the place of destination. Fourth, if it can be done, choose bearers of the same height, and should it be impracticable to do this, arrange the shoulder-straps in such a way that the litter will hang as level as possible. Fifth, in ascending an inclination, such as hill or staircase, the patient's head must be in front, and in descending it should be behind. If, however, the invalid has a broken leg, this rule must be reversed; otherwise the weight of the body would press upon the injured part, and, perhaps, aggravate the trouble. Sixth, the patient should usually be removed from the litter in the same manner as he was placed upon it.

Should neither a litter nor material out of which one can be made present itself on careful search, the wounded man must be supported in the arms, which, of course, can only be done as a general thing for short distances. If there is only one person at hand to help, and if the injured man can walk, though weak and faint from loss of blood, he must put one arm around the neck of the individual aiding him so that his hand hangs down over the further shoulder. The person assisting places his arm from behind around the waist of the wounded man, and with his other hand grasps that of the patient as it hangs over his shoulder. In this mode he can support him very efficiently, and if necessary even raise him from the ground for a few steps over difficult places, and so help him along. Should the patient, however, be unable to walk, the only resource is for the person helping him either to take him on his back, or, if not too heavy, to carry him in his arms like a child. In either case the wounded person should clasp his arms around the neck of the bearer. Should there be two people at hand to render assistance, one of the best modes is for the bearers to join hands so as to form a seat, in what is popularly

FIG. 57.



METHOD OF TRANSPORTING A WOUNDED PERSON.



called among children "Lady of London fashion," and placing the patient upon this, as shown on the preceding page, he may be transported for long distances with considerable ease. The task of the bearers is rendered less arduous if a short piece of rope or two strong handkerchiefs are knotted together so as to form a ring eight or ten inches in diameter, which grasped by each in both hands is held so as to form a seat for the patient as he is carried along, steadying himself and lightening the load a little by passing his arms around the necks of those who are assisting him. Should the patient be unconscious it will be necessary for one of the bearers to support the upper part of the body by walking behind him with his hands clasped upon the patient's chest, after they have been passed beneath the sick man's arms. The other bearer walking in front carries the legs of the sufferer, one under each arm.

The preparation of the bed for a patient who has been unfortunate enough to become the subject of a severe accident is a matter of no little importance. The couch intended for the reception of an accident case should be provided with a large sheet of waterproof material and an extra sheet folded in half and placed across the bed, so that it can be readily removed when soiled with blood or other discharges without disturbing the head and shoulders of the patient, should be arranged if the wound or injury is about the legs or hips of the sufferer. If the mattress is likely to yield to any extent with the weight placed upon it, it should be supported with extra slats. In case of wounds about the head, the pillow ought to be protected by a small piece of extra sheeting.

A patient who is not too much injured to endure the effort should always be undressed before being placed in the bed. All tight clothing about the neck should at once be loosened or altogether removed. Boots must be taken off with great care, and whilst drawing off a boot with one hand the other should always be employed to steady the limb near the ankle. If the leg is broken it is better to cut the boot down the side and nearly to the toe, than to run the risk of doing further injury to the limb by attempting to pull it off. In taking off the stocking always see that the garter has been loosened first. Pantaloon need not be cut, unless the patient's leg or thigh is injured, in which case the outside seam ought to be ripped up, so as to get them off without causing suffering to the invalid. In taking off the coat and waistcoat always remove them from the sound side first, and then they come away from that which is injured with comparatively little difficulty. When a patient who is unable to walk is brought in on a litter or stretcher of any kind, such as a window-shutter or door, the litter should be placed with its head at the foot of the bed which the invalid is to occupy, and lying in the same direction, this position being the most convenient one for transferring the sick man to his couch. To properly lift an adult patient four assistants are required, two standing on either side. One of these helpers should support the

head and shoulders, and a second the hips on one side, whilst on the other side the third assistant lifts the back, and the fourth supports the legs. In some cases the size or arrangement of the room will not permit this. The litter must then be laid alongside of the bed, and, three assistants lifting the patient into the air, a fourth rapidly withdraws the litter to allow the bearers to approach the side of the bed and deposit the invalid upon it. All the assistants should commence to lift together, and set down the patient at a given signal, special attention being devoted to the injured limb. The bed-clothes should be folded back for the whole length of the bed on one side, leaving one half of the bed laterally uncovered for the reception of the patient. By this little manœuvre they are easily replaced over a frame of wire, or of two half hoops tied together in their centres, in such a way as to protect the wounded limb from the weight of the bed coverings.

### POISONED WOUNDS.

Poisoned wounds may be caused by the bites of mad dogs, poisonous snakes, and by poisoned arrows, or other weapons. The danger in these cases is lest the virulent material introduced into the wound be carried by the lymphatics to the heart, and so poison the whole blood. To prevent this diffusion a ligature should, without a moment's loss of time, be bound around the injured limb above the wound. This is best done by an elastic belt, or a strap, cord, or handkerchief, tightened by means of a stick twisted in it Spanish-windlass fashion. After rendering this as tight as can be borne by the patient, an effort should be made to extract the poison from the wound, either by cupping, as directed on a subsequent page, or by sucking with the mouth, as one of the Queens of England is said to have saved the King's life by doing. This should not be attempted by any one who has the slightest sore or crack about the mouth or lips, although, if the mucous membrane is sound, there is little danger in displaying such devotion. After cupping or suction the injured part ought to be cauterized with a red-hot coal, a hot iron, or with caustic, such as carbolic or nitric acid, or nitrate of silver, as already directed in the article on hydrophobia upon page 437, rubbing the stick of lunar caustic thoroughly into all the recesses of the wound. In cases of snake-bite caustic ammonia or bromine ought to be used externally, brandy or some other powerful stimulant being administered internally. The usual treatment for the venomous rattlesnake's bites is to give the patient all the brandy he can take, and it is stated that, as a general rule, if intoxication can be produced the sufferer will recover.

### FRACTURED OR BROKEN BONES.

The osseous framework of the human body is composed of materials, as already explained on page 616, which are hard but brittle, and break sometimes, like glass or porcelain, by outward force, such as that of a blow, a fall, a jump, and so forth. This breakage occurs often with a snap or crack, which may be heard and felt. Fractures are classified as of two kinds, the simple and the compound, these words, however, being used in a different sense by surgeons from that which they ordinarily convey. Surgically speaking then, a simple fracture is one in which the skin is not injured, so that no matter how much the bone is broken up, there is no communication of the fragments with the external air. A compound fracture is one in which the breaking of the bone is accompanied by a wound, caused either by the same force which produced the break, as, for instance, a bullet, or by the ends of the broken bones, which are generally sharp and jagged, protruding through the skin, for example, a man may fall from a tree, breaking the femur or large bone of his thigh, and the broken end of the bone may be driven through the skin and into the ground. Compound fractures are much more dangerous than simple ones, chiefly because whenever the air has access it carries with it, apparently, irritating germs, which set up the process of suppuration or the formation of pus. Compound fractures are also more likely to be serious because the skin and muscles are much bruised, and, moreover, at the same time the bone is broken, dirt, particles of clothing, and so forth get into the wound and are with difficulty removed. When, as not infrequently happens however, the wound which communicates with the fracture and makes it compound is small, an effort should be made to gain the advantages of a simple fracture by covering the opening in the skin with several folds of clean linen soaked in a rather strong solution of carbolic acid, of fifteen or twenty drops to the ounce of water, at least until the surgeon, who should be sent for at once, arrives and takes charge of the case. This imperfect effort at antiseptic treatment, for which great improvement in modern surgery the world is indebted to Professor Lister of London, must often fail, from the impossibility of applying it quickly enough, but it ought always to be tried in otherwise suitable cases as soon as the materials can be procured.

We may recognize the fact that a bone is broken by the following indications: first, that the limb is shortened or bent where there is no joint; second, by there being an unnatural degree of movement at the seat of injury in case that occurs near a joint; third, by the violent pain which attends a fracture; fourth and most conclusive of all, by the grating which can be felt, and sometimes even heard, when the limb is moved, and the broken ends of the bone rub against each other.

The method in which nature proceeds to heal a fracture, and which



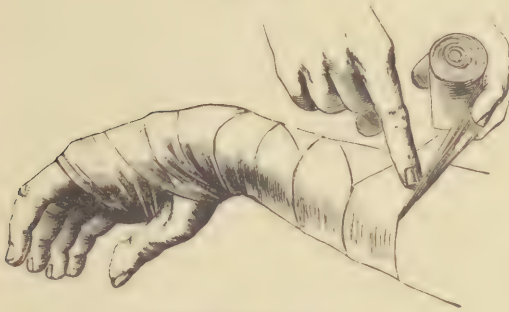
has been studied very thoroughly in experiments upon animals, which are in this, as well as many other cases, of immense service to sick and suffering humanity; is by first throwing out a quantity of new bone-substance, called *callus*, around the broken ends of the bone, thus knitting them together. At first this new material is soft like putty, but it gradually hardens, until in time it becomes just as firm as the rest of the osseous framework of the body. The period necessary for the completion of this process of hardening, varies from fourteen days to two or three months, according to the size and shape of the bone. If during all that time the fractured extremities have been kept perfectly quiet in a proper position, the bone may join with such exactness as to leave no outward sign of the injury. But if the fragments are moved ever so little whilst the callus is hardening, the bone may unite crookedly or be shortened, and cause a deformity for the rest of a person's life. The case is exactly that of a tinsmith's apprentice holding the handle of a tea-pot crooked whilst he is soldering it, and so making a misshapen utensil by his awkwardness, but the tea-pot has the advantage that if a master-workman takes it in hand, and undoing the prentice-work solders the handle on straight, it does not suffer any in the operation, whereas a human being whose broken leg has been badly cured by mismanagement on his own or some one's else part, will suffer a good deal in the hands of the master-surgeon, who must break the leg over again, and reset it in the right position, in order to restore its beauty and usefulness.

The general principles upon which surgeons proceed to secure, by the guidance of superior intelligence, a favorable application of nature's blind efforts at the healing of broken bones are, first, setting the fracture. This consists merely in pulling and pressing the fractured extremities of the bone into their proper position. Such an operation, of course, requires a full knowledge of the anatomy of the parts, and should, as a rule, be left for a skillful medical attendant, if he can be procured within twelve hours. In the mean time the wounded part should be placed in the most comfortable, or rather the least painful, posture, wrapped in cloths wet with laudanum, and kept cold with ice, in order to prevent the swelling and diminish the suffering as far as possible. When the physician succeeds in replacing the fragments in their proper positions, his next object is to secure them from being again deranged, and this is usually accomplished by the aid of splints of various kinds, such as are shown applied to the arm in figures 59 and 60. These splints may be made of wood, tin, paste-board, or gutta percha, and are kept in place themselves by bandages or knotted handkerchiefs. In certain cases material, such as plaster of Paris or starch, which stiffens after it is applied to the limb upon a bandage, and forms a trustworthy casing, can be employed with great advantage in the treatment of fractures.

When a person is injured far from any habitation, and must be moved

a considerable distance for shelter and medical assistance, if it is found that a bone has been broken by examining the injured part, as above directed, the first thing to do is to apply a bandage to the fractured limb, and then to fasten on it a temporary splint, which will prevent the injury from becoming compound, if it is as yet only a simple fracture, and may save the wound from being irritated, if the injury is already a compound one, as previously defined. Bandages may be made in case of emergency from any cotton, linen, or woollen fabric, but if circumstances permit the choice, part of a linen sheet, not so old as to be tender, should be torn into strips two inches wide for arm bandages, and about three inches wide for leg bandages. Three of these may be sewed together so as to make a strip about six yards in length, which is to be tightly rolled up in the form indicated in the figure. The operation of bandaging requires some

Fig. 58.



APPLICATION OF A BANDAGE.

practical experience before it can be performed neatly. The idea, however, of the method of procedure, winding the cloth smoothly around the arm, for instance in a spiral direction, can be gathered from the illustration. Where the limb is conical, increasing in size from below upward, the only way to cause the bandage to lie evenly and be of much use is to

make what are technically called reverses, turning the roll of linen over each time as it comes on top, as is represented in the woodcut. The artist, however, has delineated the surgeon's fingers as being those of a left-handed man, a variety of the human species which, strange to say, is tenfold more numerous in pictures than in real life. The best substitutes for bandages available at a distance from human habitations are often to be found in handkerchiefs. Sometimes these serve an excellent purpose, and, in fact, a system of handkerchief bandaging, contrived by an ingenious Frenchman some years since, has frequently proved very useful in cases of emergency.

To obtain splints for the temporary support of fractures the most varied articles have been pressed into service. Thin, light boards, like shingles or the sides of a cigar-box, which can be cut into any form desired, are often the best, but any object which may be trimmed or bent to suit the exigencies of the case, and is stiff enough to retain the form given to it, can be utilized. After preparing the splint it should be padded, for which purpose cotton-batting, tow, old rags, dried leaves, or hay may serve, these materials being bandaged fast to it on the side which is to come in contact

with the injured member of the patient's body. The apparatus is then applied to the limb, an arm for example, as shown in the figure below, and after carefully adjusting the injured member in the least painful position, as well as that which is nearest its own natural shape, the splint or splints are fastened in place with several turns of the bandage applied as previously suggested. The adjoining woodcut shows the method of applying the splints for a fracture of both the bones of the forearm between the elbow and wrist. In this accident, since it is very important that the motion of rolling the radius around the ulna, described on page 617, should be preserved, the splints are made broader than the width of the forearm, and thus prevent the bandage from pressing the two bones together. For

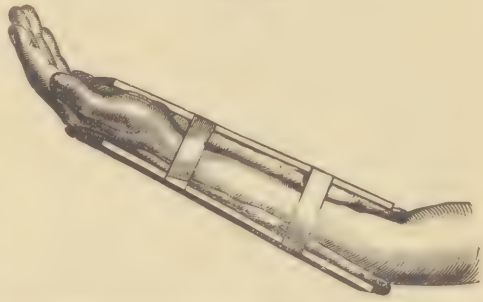


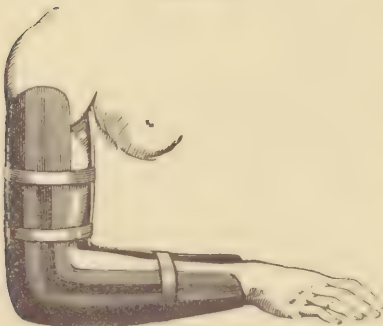
FIG. 59.

TREATMENT OF FRACTURE OF BOTH BONES OF THE FOREARM.

the same reason no bandage is to be applied to the arm before the splint when this particular fracture is treated. On the contrary the splints should be so padded as to have a slight ridge along their middle, and so tend to pry the bones apart. After arranging the arm and splints as depicted the whole should be covered in with a bandage, and suspended by a sling from the neck in such a way as to be carried by the patient across his chest, with the elbow bent at a right angle and the thumb pointing directly upward as the injured person stands erect.

Fracture of the humerus or arm-bone between the shoulder and elbow should have applied a curved splint made of thick pasteboard, wet in

FIG. 60.



FRACTURE OF THE HUMERUS.

boiling water and moulded to the shape, sheet gutta percha similarly softened, or tin, on the inside and another on the outside, as represented in the figure. The fragments of the bone are to be adjusted in proper position, a bandage applied, and then the splints fitted and firmly yet not too tightly bound on with a bandage running from the tips of the fingers to the shoulder. If the roller is applied above only, the hand and fingers will swell up in consequence of the

pressure, interfering very seriously with the circulation of the blood. In fractures of the arm it is always advisable to arrange the elbow bent at a right angle, because should the arm be left stiff, as may happen



perhaps with the best treatment, it is much more useful than when straight.

In fractures of the legs a contrary rule holds good, and the effort should always be to keep the broken limb as straight as possible, seeking also by a great variety of surgical appliances to hold it stretched out to its full length, and so prevent a shortening which would render the patient lame for life.

An excellent temporary dressing for a fracture of the leg below the knee is well indicated in the figure. The injured limb should be drawn

FIG. 61.



DRESSING FOR BROKEN LEG.

out to as nearly its full length as can be borne, measuring it by the sound side to determine this, and then the fragments of the bone pressed, if possible, to their proper places. The pillow which has previously been laid beneath the injured member is then doubled up, as shown in the cut, and fastened with three or four

strips of bandage or of handkerchiefs. If the leg is much bruised, or the pain very severe, a soft linen rag soaked in laudanum, or strong lead-water and laudanum, should be wrapped around it, allowing the soothing application to extend a couple of inches above and below the most painful part, the whole being covered with oiled silk or gum cloth before being bound up in the pillow.

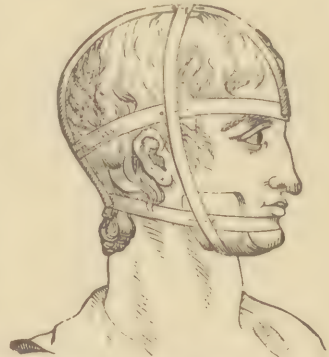
The detailed treatment of the various fractures of the limbs is so very complex that it could hardly be understood without much preliminary anatomical study, and would after all be just as useless in managing a bad fracture as a general knowledge of watch-making without practical familiarity with the tools would be in repairing a broken timepiece. From the examples given, however, it is hoped that some idea of how to make a patient as comfortable, and keep him in as favorable condition for the surgeon when he arrives, as is possible under the circumstances, can be gleaned. Although it is best that a doctor should see the invalid as quickly as he can, yet as the callus or uniting material is not thrown out for two or three days, and often does not begin to harden for a week, it is obvious that most important service in remedying any mal-position of the fragments can be accomplished by skilled medical treatment arriving any time within that period. The first setting has not by any means, therefore, the vast importance popularly attributed to it.

Compound fractures, if not treated antiseptically, may be managed by covering them with cloths soaked in lead-water and laudanum, and supporting them with splints, which must be loosely applied. Compound fractures of the leg often do best when packed in bran, contained in a box

with hinged sides, called a fracture-box, and changed daily. Union of the fragments is very slow in these cases, and sometimes weeks, or even months, elapse before nature makes any effectual effort at repair.

As an example of special arrangements required in particular parts the ingenious method of treating fracture of the lower jaw is worthy of notice. The splint, as seen in the figure, may be made of sheet gutta percha, or thick pasteboard dipped in hot water, and moulded to the face whilst soft. It is held in its place by narrow bandages, arranged as indicated, so as to form a kind of open basket work around the head, and retained in position by pins or stitches at the points where the different turns of the roller cross each other. The inside splint for such a fracture is best supplied by the teeth of the upper jaw, should the dental furniture be complete. The patient may be nourished by a tube carried through the opening made by extracting a tooth, or around the back molar teeth of the sound side, or nutritive injections may be resorted to.

FIG. 62.

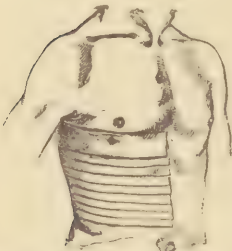


SPLINT AND BANDAGE USED FOR FRACTURE OF THE JAW.

Fracture of a rib would at first sight appear to be extremely difficult to treat, but as shown in the drawing the ingenuity of surgeons has devised a method for putting the broken bone so nearly at rest that satisfactory cures are generally obtained. The lower part of the chest on the affected side is covered with broad, overlapping strips of adhesive plaster, running just half round the body, drawn very tightly, and preventing in great measure the movement in breathing, which might result in non-union

of the fractured rib. This compression of the side, which in health would be quite distressing, is often a great relief to the patient by diminishing the scratches some sharp corner of the broken bone inflicts upon the sensitive lung or its pleural covering at every breath.

FIG. 63.



TREATMENT OF BROKEN RIB.

In fractures of the leg and thigh, and especially in compound fractures of these parts, when prolonged confinement to bed, lying constantly on the back, is absolutely necessary, the great care already recommended in typhoid fever and in paralysis to avoid the formation of BED-SORES, is of immense importance. These troublesome, dangerous, and sometimes even fatal complications of injury and disease, may vary from slight abrasion of the skin, with a little diffused redness around it, to large, deep sores, a foot in diameter, and involving all the tissues

down to the bones. They occur over the prominent parts of a patient's body upon which the weight specially rests whilst lying in bed, as, for instance, the sacrum or lower part of the spine, the hips, the points of the shoulder-blades, and so forth. The rules for preventing their occurrence, as far as lies in our power, are as follows: First, keep the under sheet of the bed smooth and free from wrinkles or crumbs; second, the patient must be kept as dry as possible, all discharges being cleared away immediately after their occurrence; third, the position of the patient should be varied slightly, as frequently as permissible, so as to divide the weight and avoid any constant pressure upon one spot; fourth, the back should be examined *daily*, washed with bathing whisky or alcohol and water, and, after being thoroughly dried, dusted with starch, infant powder, or oxide of zinc; fifth, when any indication of congestion, or even the faintest persistent redness appears, the patient should be supplied with a water- or air-cushion, and the affected part covered with soap-plaster which has been spread on thick, soft leather, in two layers, the under one having a hole cut in it to relieve the pressure over the threatened sore. Water-beds are of great service, but are often difficult to procure, and to keep in good order. When the skin is once broken, the bed-sore must be treated like any other similar injury.

### DISLOCATIONS.

Continued displacements of the bones comprising a joint after the ligaments have been more or less torn constitutes a dislocation, or, as it is popularly described, a being out of joint. These injuries are generally the result of external violence, such as falls, blows, twists in wrestling, and so forth, which have caused the



FIG. 64.

DISLOCATION OF THE LOWER JAW.

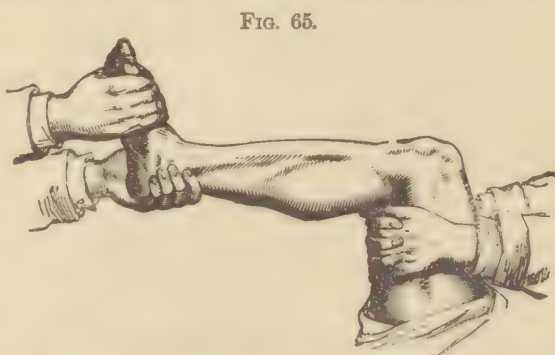
limbs to move in a direction, or to an extent, for which nature had not adapted them. A familiar example of a dislocation is that of the lower jaw, and the position of the bones composing this important articulation in their disturbed or displaced condition is well shown in the marginal illustration. When a person's jaw is thus thrown out of joint, as sometimes happens from a violent blow of the fist, the sufferer is unable to close his mouth, so that, of course,

speech is very much interfered with, and chewing is impossible. The obvious remedy for the trouble is to pry down the jaw and slip it back, but it is held in its position, or rather malposition, by such powerful



muscles, which are stimulated to spasmodic contraction by the strain put upon them, that this is difficult to accomplish unless a little ether is inhaled, and the spasm thus relaxed. In reducing a dislocation, that is restoring a bone which is out of joint to its proper place, not only should the operator have all his anatomy at his fingers ends, but a vast amount of practical experience is often necessary, to decide whether a dislocation is complicated with a fracture, or whether a dislocation or a fracture is the injury to be treated. In a general way a dislocation is recognized, first, by the altered appearance of the joint, which is usually very apparent when compared with the corresponding joint on the opposite side, provided that is in a sound condition; second, by the movements of the affected joint being lessened; third, by the fact that efforts to move the joint cause much pain; fourth, dislocation can usually be distinguished from fracture, which, when near a joint, is apt to give rise to all these symptoms, by the absence of *crepitus*, as the grating noise produced by rubbing together the ends of the fragments is called. This sign, however would, of course, prove fallacious and misleading if both a fracture and a dislocation existed.

So great and so permanent is the injury likely to result from the blunders of attempting to "reduce" a fracture, erroneously supposing it to be a dislocation, or *vice versa*, that no time should be lost by the sufferer in availing himself of the best medical services procurable. If circumstances prevent this, or render immediate action necessary, as may occasionally happen, the best way for the acting surgeon who undertakes, in spite of his ignorance, to remedy the difficulty is, as a general rule, to find some one who understands giving ether, and after having the patient cautiously brought under the influence of this anæsthetic, to try by gentle pulling, pushing, and kneading of the joint, whilst the subject of his operation is perfectly relaxed, to bring the bones back to their natural position, as judged by the appearance and so forth of the corresponding joint of the opposite side. No violence should be used, however, since there is no muscular resistance to overcome, and if the right movement is hit upon the bone easily slips back into its socket and the trouble is at once relieved.



METHOD OF REDUCING A DISLOCATION OF THE ANKLE JOINT.

An illustration of the principles upon which such an operation must be performed is given in the margin, which shows the method of reducing

a dislocation of the ankle joint. The patient lying upon his back on a narrow bed or lounge, and being fully relaxed by the effect of the ether inhaled, an assistant lifts up the injured limb and holds it so that the thigh is bent at the hip in a right angle to the body. The acting surgeon then seizes the foot in both hands, and drawing it towards him with some force twists it inward or outward, or presses it backward, as the case may be, until, if successful, the proper contours of the foot and leg are restored and the natural movements regained.

After the reduction of a dislocation the joint should be dressed with lead-water and laudanum, bandaged, and placed on a splint, which will keep it quiet for a day or two, or even a week, until the active irritation produced by the injury passes away. When this subsides, however, use of the limb should be resumed cautiously, but without unnecessary delay, in order to avoid a stiff joint.

### SPRAINS.

Sprains are injuries resulting from the twisting or tearing of the ligaments surrounding a joint by the effects of a fall or blow. Sometimes the violence of muscular action, or the sudden weight of the body, brought to bear upon a joint when unexpected by the antagonistic muscles, may be the cause of a sprain. The pain is frequently very sharp and severe, and swelling takes place with great rapidity. The most common sprain is that of the ankle, and its effects are so speedily manifested that in the course of a few minutes the patient becomes unable to walk or even put his foot to the ground without great suffering.

*Treatment.*—The treatment is perfect rest, with the affected ankle elevated above the hip, and the application of cold water, by wet clothes for an hour or two, and then dressing with strong lead-water and laudanum. Frequently the constant flow of cold water from a pitcher or by the aid of a couple of sponges upon the seat of injury affords most relief at first. If the agony is intense leeches and opiates may be necessary. Convalescence is often tedious, and yet time is only lost by attempting to use the affected limb before it is sufficiently restored.

### BRUISES, ULCERS, AND SORES.

Contusions or bruises are often treated with home remedies, such as salt and water or vinegar, but can be best managed by applying the usual means of subduing inflammation and relieving pain, namely, the lead-water and laudanum dressing, already so often recommended. A good proportion of the ingredients to use where the skin remains unbroken is two tea-spoonfuls of laudanum, two of Goulard's strong extract of lead, and three table-spoonfuls of rose-water. Where the skin is broken, how-

ever, the alcohol in the laudanum sometimes smarts severely, and with children, at any rate, it is better to use a solution of acetate of morphia and lead-water, as advised on page 374 in the treatment of erysipelas, if it can be readily procured.

Ulcers and sores arising from injuries or other causes are to be treated, if much inflamed, with cloths soaked in lead-water and acetate of morphia or laudanum, kept moist, of course, by being covered with oiled silk. If a slough or core appears it should be poulticed with flaxseed, bread and milk, or yeast prepared as directed on a subsequent page, and after the inflammatory stage is overcome, and that welcome sign, a pearl-colored margin surrounding rose-tinted healthy granulations, appears, a simple dressing of lime-water on soft rag covered with oiled silk, or if moist applications begin to disagree the benzoated oxide of zinc ointment, oleate of lead cerate, or iodoform powder is generally all that will be required.

PARONYCHIA is a boil or abscess upon the thumb or fingers, only two well known to many unfortunate persons by the unpopular name of a felon. The agonizing suffering from this affection is so great that many people after going through with it once declare they would rather have the finger cut off than endure it again. It may, however, in the writer's opinion, be prevented at the beginning, as a rule, by lancing the spot where the intense warning soreness first commences, cutting down to the bone, or at least far enough to find the tiny particle of yellow slough or core, which seems to be the cause of the whole trouble. If a way for this to get to the surface is opened with the lancet, and kept open by a few threads of linen cloth, it usually resolves itself into a very small boil, instead of costing the patient from four to seven days of such suffering that night after night he must walk the floor in agony. If a felon is allowed to go on, when ripe enough to lance the operation is so painful that nitrous oxide gas or ether may generally be used to prevent the incision from being felt. The early lancing above advised can usually be rendered sufficiently painless by the local application of ether spray or of a freezing mixture. Sometimes rubbing a couple of square inches of the surface around the spot of warning soreness with a moistened stick of lunar caustic so as to completely blacken the skin seems to cut short a felon and may be tried before lancing is resorted to.

## FOREIGN BODIES IN THE THROAT, NOSE, EYE, AND EAR.

Foreign bodies, or objects which do not belong in the throat, are sometimes substances imprudently swallowed by mistake, such as fish bones, pins, and so forth, or coins, marbles, and other playthings half ignorantly introduced by children. If the breathing is not seriously interfered with, medical assistance, sent for at once, should be awaited, as peculiar forceps and other instruments will probably be necessary to extract the



intruders. If choking to death seems imminent from pressure on the windpipe, thumping on the back, holding the patient up by the heels, and striving to hook out or push the foreign body, if it is not intrinsically dangerous, down into the stomach, may all be tried. At the last gasp the operation of tracheotomy or opening the windpipe should be performed by any one who has the knowledge and the nerve to attempt it. A sharp penknife blade should be thrust into the exact middle of the throat about an inch and a half, in an adult, below the projection called Adam's apple, at a spot where the rings of the trachea (see Fig. 10 and at *f* in Fig. 19) can usually be felt at the depth of a quarter of an inch or so under the skin. A cut straight upwards of about half an inch long is to be made in the front wall of the windpipe and the sides of the wound held open by means of a couple of spoon-handles, or hair-pins bent at their closed ends so as to make blunt hooks adapted to the purpose, so that air can enter to the lungs. If a person actually chokes to death he may possibly be saved by this operation of tracheotomy if done within two minutes of the last breath, and supplemented by artificial respiration as recommended in drowning cases on page 100.

Foreign bodies in the nose are generally beads, buttons, and so forth, pushed up by children with the usual desire to see what they will do. They may sometimes be driven out by violent sneezing, excited by putting up snuff or tickling the inside of the nostril with a feather. Steel in the form of slender surgical forceps with sharp teeth is the best remedy. If seeds of various kinds, such as grains of corn, dried beans, and so forth, which are often introduced by children, cannot readily be sneezed out, it is doubly important to call in a physician promptly, because these objects may soon swell up by absorbing moisture from the lining mucous membrane and become wedged in so tightly as to render extraction dangerous, or well nigh impossible.

Foreign bodies in the eye are usually particles of dust or fragments of half-burned coal blown in during railway journeys, and it is astonishing how much pain may be caused by an atom less in size than a grain of writing-sand which finds its way beneath the upper eyelid. Nor is it a question of temporary suffering only, for the sight may actually be lost by subsequent inflammation if the cause is not promptly removed. Should the offending particle lie beneath the lower lid it can generally be extracted with comparative ease by pulling down the eyelid, searching out the cinder by the aid of a bright light and a magnifying glass, and cleaning it off with the rolled up corner of a fine handkerchief, which has been touched with a drop of mucilage. Objects beneath the upper lid are more difficult to manage. If the popular mode of wiping the inside of the upper lid with edge of the lower one, over which it is drawn down, fails to give relief, the lid should be at once inverted or turned inside out, so as to get at the particle. This little operation is performed

by taking hold of the eyelashes, pulling out the lid from the eye, and having the patient look down at his feet just as you press the back part of the lid down with a bodkin or thin lead-pencil laid across it above the eye. The particle will generally be found adhering to the under surface of the lid, and when detected should be removed as before advised.

Foreign bodies in the ear may generally be extracted by syringing, which is far safer than attempts to pick them out with any but the best surgical instruments. If a seed is in the ear, the auditory canal (see Fig. 36) ought to be filled with oil for an hour or two before using the syringe, so as to diminish the danger of the vegetable structure being swollen up by the water injected. Should an insect creep into the ear, let the suffering patient lie down on the opposite side, and fill the auditory canal with sweet olive oil, or with glycerine, for the purpose of killing the creature and perhaps floating it out on the top of the liquid.

### BURNS AND SCALDS.

Accidents by fire are among the most painful, and yet most common, misfortunes of civilized life, and every one should be informed as to what is best to do in such emergencies. Even when small and slight, the suffering produced by burns is severe; when extensive, they are dangerous, and if the whole body is involved certain death is the result. Burns are caused by the intense heat of fire, or by chemical agents applied directly to the surface, destroying the skin, and, to a greater or less extent, the tissues underneath. Scalds are produced by the contact of boiling liquids or steam. The three degrees of a burn are, first, mere painful redness, caused by superficial inflammation of the cutaneous surface; second, the formation of blisters; third, charring of the skin, and, perhaps, of the deeper structures. Probably, the most frequent cases of fatal burning are from the clothes taking fire in consequence of playing with matches, lighting fires with kerosene, and other imprudences, which, for some people, seem to have a peculiar fascination. When the clothing takes fire, the person, if alone, should throw himself flat upon the floor, and strive to smother the flame by wrapping around him a rug, shawl, coat, or any woolen article within reach. If any other person is present, he should instantly trip or knock down the sufferer, and use his coat or the first woolen article which comes to hand to smother out the fire; then procure water as quickly as possible, and drench the patient with it as the smouldering clothes continue to burn into the flesh. In the terrible cases which occur, especially in ladies and children, where the whole clothing is burned off and the entire body is one vast blister, the best way is to give a large hypodermic injection of morphia, or a full dose of laudanum, and roll the patient in a sheet after covering the body with sweet oil and dusting it with flour. Death is inevitable, and all that humanity can do,

is to dull the sensibility to pain. Indeed, if the patient is suffering great agony, which is not always the case, as the shock and fright sometimes mercifully act the part of a narcotic to a certain extent, ether or chloroform should be administered until the opiate has its soothing effect. In burns of lesser extent, where there is a chance of recovery, one of the best applications is linseed oil and lime-water, commonly known under the name of carron oil. This should be applied over the whole of the burned surface by means of rags soaked with it, and renewed as often as they begin to grow stiff and uncomfortable. The same relief of suffering by the use of ether and morphia or laudanum is even more urgently called for. If the linseed oil and lime-water cannot be procured at once, sweet or olive oil, fresh lard oil, or castor oil may be used temporarily. If any blisters have formed, they may be punctured with a needle, and the water thus allowed to drain away; but the skin should be saved as long as possible, since it forms the least irritating covering for the raw sore left underneath.

For small burns, where the skin is not broken, a strong solution of common baking soda is a good application, as is also the carron oil already spoken of. Paste, glue, and white paint have all been strongly recommended. Dipping the part in cold water affords great relief from pain, and is good though troublesome treatment, if it can be applied, as, for instance, to burns upon the hand or foot.

Burns of the first and second degrees, above mentioned, are likely to prove fatal if more than one-half the surface of the body is involved. If more than one-fourth the body is burned, so that the skin is destroyed, and a broad, shallow ulcer is left, which must heal up by granulation, the patient will probably succumb to the drain upon his system and to the pain in the sore; whilst, if more than one square foot of the body is deeply charred, death will almost certainly result. If, immediately after very extensive burns, the patients—particularly should they be in the age of childhood—are quiet, experiencing little pain, only sighing occasionally and asking for water to drink, it is generally a sign of speedily approaching death. Burns from falling into a lime-kiln or a kettle of soap-lye, should be treated with plenty of cool water, and then washed with diluted vinegar, except where the skin is broken, to neutralize the alkali; afterwards, the burns which remain are to be dressed with oil, as directed for those which have been produced by fire. Burns from acids, such as nitric acid or oil of vitriol, should, on the contrary, be treated by profuse washing with lime-water, a weak solution of baking soda, or any other alkali which can be procured.



## POISONS AND THEIR ANTIDOTES.

The production of disease, dangerous or fatal in its character, by the introduction of deleterious substances into the system, usually by the avenue of the stomach, is lamentably common, and it is strange that greater efforts have not long since been made to teach children from their earliest youth how to recognize and avoid the poisonous vegetable and mineral agents with which they may come in contact, and what antidotes to employ in case these noxious substances find entrance into their systems. If one single hour a month were devoted in all public and private schools to teaching the youth of America how to escape being poisoned, and how to remedy the effects of poison accidentally introduced into their bodies, what a far more practical advantage it would be to them than the knowledge gained in regard to many of the accomplishments which occupy so much time and attention in educational establishments.

Under the head of poisons, it is intended to include all those substances which exercise pernicious, as distinguished from medicinal, effects upon the human body, tending to disturb its action or organization injuriously in a powerful degree, and if not remedied to cause death. Such substances may be swallowed, or taken in by the breath, absorbed through the skin, or the thinner and more delicate mucous membranes, or implanted by bites, stings, or other punctured wounds.

In many cases persons are aware almost immediately after the act that they have swallowed a poison; but in many others, also, no suspicion is entertained at first. In a general way, it may be stated that it is reasonable to surmise a person has swallowed some poisonous substance, if, shortly after taking food or drink, he is seized with violent pain in the stomach, with vomiting and purging, especially if convulsions or paralysis are present, or if the individual suffer from marked giddiness or delirium, or should there be a great tendency to sleep. The first thing to do is to send for the nearest reputable physician, and any neglect of this involves a heavy responsibility if the illness prove mortal, as it is certainly very possible that it will do.

In the mean time not a moment should be lost. There are three rules which should always guide an effort to remedy the effects of poison, no matter what it may be: First, to get rid of the poison; second, to stop its effects; and third, to remedy the evil it has done. In carrying out the principles thus inculcated, whatever is readiest is best; for the poorest remedy given at the moment, is better than the most appropriate, administered an hour later. A considerable number of poisons are what might be called self-evacuating; that is, having been swallowed, they set up vomiting and purging, and are thereby eliminated. In such cases, all that is needful is to aid the self-evacuating process, especially to assist the

vomiting, and so, perhaps, get rid of the poison altogether. If vomiting, however, has not occurred, or has not been profuse, the first thing is to bring it on immediately. The three handy emetics are, usually, mustard, common or kitchen salt, and luke-warm water. If we have a choice, mustard should be used in poisoning where the noxious substance has had a sedative influence, and it is less applicable to those cases where an irritant effect has been produced. The dose of mustard is a table-spoonful, stirred up in a pint of warm, not hot, water, and, after drinking it, the patient should swallow as much warm water as his stomach will hold, both to dilute the poison and to promote the action of the mustard. After a few minutes, if no signs of vomiting appear, the back of the throat ought to be tickled with a feather, or roll of paper, which will often hasten the emetic effect. When the stomach has emptied itself, it is well to repeat the process, so as to give it a good washing out. Should there be no mustard at hand, salt water, mixed in the proportion of a small handful to a pint of luke-warm fluid, and followed by copious draughts of the warm fluid, as before suggested, and tickling the throat if needful, will generally answer the purpose. It is a good plan to send at once to the nearest drug store for some wine of ipecacuanha, to be administered in table-spoonful doses every ten minutes, should the ordinary home remedies fail in their customary energetic effect.

In some instances, this treatment is all that is required, but frequently the simple plan of getting rid of the poison will not suffice. Its effects must be neutralized or remedied, or, in other words, some antidote is needed. Now, no one antidote is suited to all emergencies. The antidote is required to be adapted to the poison, and therefore an effort should be made, instantly after the emetic is given, to find out what kind of a noxious substance has been swallowed, and the proper remedy should be administered in accordance with the following suggestions. The object of most antidotes is to render the active poison an inert substance, after which treatment may be instituted with a view to remedy the mischief which it has previously done. Antidotes, therefore, are generally chemical agents, which attack or combine with the poison in such a way as to render it insoluble, and so inert. But some are medicines, the virtues of which are apparently opposed to the active qualities of the poison, constituting what may be correctly called counter-poisons.

If we are totally ignorant of the kind of poison which has been swallowed, as may occasionally happen, the treatment is first to provoke vomiting, as already advised, and after the stomach is completely emptied, to give a moderate quantity of some bland liquid, such as milk, eggs beaten up with milk, or sweet oil. If the patient feels cold, and the skin is cool and clammy, a little wine or brandy well diluted may be administered; and if he seems drowsy, narcotic poisoning is to be suspected, so that strong coffee, and belladonna under the direction of a physician,

should be employed. If the prostration is very great, stimulants freely, heat to the skin by hot-water bags or bottles, and mustard plasters to the abdomen, are to be resorted to.

When the kind of poison which has found its way into the stomach is known or strongly suspected, the proper antidotes are as follows. As enumerated below, they should be faithfully administered, even though the symptoms seem to be very much relieved by the occurrence of vomiting.

Among the most common poisons are the metals and their salts, particularly arsenic, lead, copper, mercury, and antimony. The general symptoms of such poisoning are those of irritation, rapidly running on to inflammation of a more or less acute form, in the stomach and intestines. This inflammation may be so violent as to lead to speedy ulceration through the coats of these organs, or if the metallic poison is swallowed in sufficient quantity, it may corrode the tissues and directly perforate the stomach or gullet. Intense burning sensations in the pit of the stomach are followed by purging and colicky pains, a sense of tightness in the throat, violent cramp, and persistent vomiting, in most cases of severe metallic poisoning.

For arsenic the best antidote is the hydrated peroxide of iron, diffused or mixed up through water, or the freshly-precipitated oxide of iron. Whilst this is being brought from the apothecaries, give the whites of three eggs, or a table-spoonful of wheat flour mixed up smoothly with half a pint of water.

The treatment for poisoning by Paris green, which contains arsenic, is identical with the above.

For the salts of copper, such as blue vitriol, after vomiting, give the white of eggs beaten up with milk, or sulphate of iron, or a little carbonate of zinc in the form of white zinc paint may be used.

Injurious effects of mercury and its salts, of which corrosive sublimate is that most likely to be used as a poison, should be treated in the same way by white of egg in abundance; or strong, green tea may be used until eggs are procurable.

Antimony, especially in the form of tartar emetic, is peculiar in that it produces symptoms of great prostration. Vomiting should not, therefore, be urged after the stomach has once been emptied; but strong, black tea made by boiling, or tannic acid in any other form, should be given.

Chloride of zinc, which enters into some of the popular disinfectants, should be neutralized by copious draughts of soap and water, or carbonate of soda, the common baking soda, dissolved in water, in the quantity of a table-spoonful to a pint. Eggs and milk may also be used.

Lead and its salts produce constipation, and later, lead-colic and palsy. The best antidote at the time of swallowing is some soluble sulphate, such as Epsom salts or Glauber's salts. The subsequent treatment is by



iodide of potassium, in doses of five or ten grains dissolved in a table-spoonful of water, three times daily.

The second group of poisons is that composed of the caustic alkalies—potash, soda, and ammonia—the only common one of which is the concentrated lye sold largely for making soap. The symptoms of poisoning thus produced are a violent burning sensation in the mouth and throat, difficult and painful swallowing, vomiting of bloody material which turns yellow turmeric paper brown, colic and purging, the evacuations being bloody; cold sweats and hiccoughs precede the fatal collapse. The treatment is by vegetable acids, such as lemon juice or vinegar and water, or, if they are not at hand, linseed or olive oil in abundance.

The third class of poisons are the metalloids, such as iodine and phosphorus. Their symptoms are similar to those of the corrosive metallic compounds.

The antidote for iodine is starch, which may be given mixed with water, or as flour and water, or arrow root. No good antidote for phosphorus is known, but after vomiting, mucilaginous drinks with magnesia are recommended. Phosphorus poisoning is very painful and fatal.

The fourth class comprises the acid poisons, such as oil of vitriol, nitric acid, oxalic acid, and carbolic acid. For all these, except the last, lime is the most convenient antidote, and should be given abundantly, mixed up with a good deal of water. Chalk, whitewash, and whiting are different forms of lime, some of which can probably be procured without much delay; but, unfortunately, these powerful acids accomplish their evil work so quickly, that antidotes often fail to be of service to the sufferer. Distressing contraction of the throat is apt to follow recovery from the immediate effects of the caustic acid and alkaline poisons, and may prove fatal.

The fifth group is made up of the vegetable poisons, the effects of which are either irritant, or narcotic, or a combination of these two influences. The type of the narcotic poisons is opium, which, with its preparations, laudanum, morphia, black drop, and so forth, causes a large proportion of the deaths by poisoning. The effect is that of benumbing the nervous system, resulting in from one to two hours in profound stupor, during which the pulse and respiration grow slower and slower, until, at last, if the dose is very large, death takes place from paralysis of the respiratory muscles. The pupils of the eyes are greatly contracted. Convulsions may occur before death.

The treatment of opium, laudanum, or morphia poisoning is by active emetics, following up those already advised with ten or twenty grains of sulphate of zinc, or four grains of tartar emetic where a large dose has been swallowed, in half a pint of water, and repeated in ten minutes if vomiting is not quickly produced. As the stomach is rendered very insensible by the action of the narcotic, a stomach-pump, or its best home substitute, the Davidson's syringe, with the lower end of the inlet-pipe

slipped off, should be used as quickly as possible. Strong coffee, but no alcohol, ought to be administered, and the electrical current from a battery passed through the chest to stimulate the respiratory muscles, with, finally, artificial respiration as explained on page 100, are often necessary. The hypodermic injection of atropia is highly recommended. Care must be taken to watch the patient for at least twelve hours after he begins to recover, as relapses are frequent and may come on unexpectedly.

Poisoning by belladonna or deadly nightshade, and by stramonium or jimson-weed, are to be treated on the same general principles as opium poisoning. They are, as a rule, much less dangerous.

Prussic acid and cyanide of potassium generally prove fatal so quickly that there is no time to give an antidote; but ammonia and also the oxide of iron are advised. If the poison is swallowed in the milder forms of oil of bitter almonds, or cherry laurel water, which contain prussic acid, these antidotes should be used.

The effects of aconite, and the other irritant vegetable poisons which enter into the composition of certain liniments, and thus may be swallowed by mistake, are best met by astringents, such as tannin, boiled black tea, or decoction of oak bark, followed by milk and oils.

Strychnia poisoning is attended with violent spasms, like those of tetanus or lockjaw, and like them, must be treated, after free vomiting, with chloral, inhalations of chloroform, and, perhaps, curare or woorara.

Alcohol, usually in the form of brandy, rum, or gin, if taken in great excess, acts as a powerful poison, and may directly produce death. The symptoms are insensibility, slowness of the pulse and respiration, and coldness of the hands and feet. The treatment is by emetics, aromatic spirits of ammonia or hartshorn, and external warmth. Long continuance of smaller doses of this poison are apt in time to produce that curious disease, delirium tremens, or the trembling delirium of drunkards, the great characteristic of which is fear, especially of the realistic vision of snakes, frogs, toads, and other repulsive reptiles, by which the poor wretch is tormented. Still smaller doses bring on the condition of chronic alcoholism, which usually results in organic change of the liver, kidneys, or brain, ultimately proving fatal as already pointed out in detail earlier in the volume.

Poisoning by mushrooms and other fungi, seldom seen in this country, is characterized by vomiting, purging, great thirst, convulsions, and fainting fits, tending to collapse with delirium, dilated pupil, and coma. The treatment is by emetics, such as sulphate of zinc, followed by purgatives, like sulphate of magnesia, after which chloric ether and diluted brandy should be administered.

The animal poisons are grouped into the seventh class. These are mainly in the form of unwholesome meat, decaying or changing in some peculiar and as yet unknown way, as in the poisonous sausages already referred

to. Cheese and fish in certain conditions are poisonous. The symptoms of fish poisoning come on in an hour or two after partaking of the dainty, with distress in the stomach, giddiness, and headache, sometimes nettlerash, generally vomiting, and occasionally fatal collapse of the vital powers. The treatment is by emetics, followed by saline purgatives and alkaline drinks.

The eighth class comprises the gaseous poisons like chlorine and carbonic acid. The symptoms of chlorine poisoning are those of violent irritation of the air passages and lungs, which may run on to severe inflammation. Carbonic acid can only be breathed after dilution with at least two volumes of air, and atmospheric air is deadly if it contains more than one-tenth its bulk of the gas. The effects are vertigo, drowsiness, and complete prostration of muscular power, the breathing becoming stertorous or snoring, and death taking place by coma. The antidotes for ill effects of breathing chlorine-vapor are the vapor of ammonia and sulphuretted hydrogen, very cautiously inhaled. In poisoning from the gas from burning charcoal, or from the choke-damp of miners, or the gas which extinguishes flame in old wells and deep excavations, which are the usual forms in which human beings are exposed to the ill effects of carbonic acid, artificial respiration should be employed to pump the poisoned atmosphere out of the lungs as speedily as possible, and if the surface of the body is warm, the cold douche to the head and back of the neck ought to be employed; if the patient is cold he should be immersed in a hot bath. When respiration is fully re-established bleeding from the arm may be necessary to relieve the congestion of the blood-vessels of the brain induced by the action of the poison.

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## CHAPTER XVII.

### NURSING THE SICK.

THE growing conviction not only among physicians but through the community at large, that in many diseases nursing is of more practical importance than medicine, renders a special chapter upon the care of the sick necessary in such a volume as this, as well as in more strictly professional works. Many important details of the art of nursing are easily taught, and yet it should be clearly stated at the outset that these are



miserable substitutes for the great qualification of a nurse, which consists in his ability to be unremittingly kind, gentle, and patient with the peevish waywardness displayed by almost all human beings when in the unhappy condition of disturbed health. No amount of knowledge, skill, tact, or intelligence, can serve as compensation for this grand recommendation, and with it the proper acquirements of a well-trained nurse make him almost invaluable both to physician and patient.

Miss Nightingale, whose vast amount of personal experience has enabled her to write one of the best books on nursing ever given to the world, contends that nursing ought to signify the judicious use of fresh air, light, warmth, cleanliness, quiet, and the proper selection and administration of diet, all at the least expense of vital power to the patient. Most of these subjects have been already discussed in detail in the earlier part of this book, which can be most profitably consulted by every one who undertakes to attend upon sick people.

Besides the general care about ventilation and warmth, a good nurse will keep a constant watch over invalids, especially over weak, protracted, and collapsed cases, to guard against any particular evil effects of the loss of vital heat. In certain diseased states much less heat is produced than in health, and there is a constant tendency to the decline and the ultimate extinction of the vital powers, in consequence of the call made upon them to sustain the heat of the body. Cases in which this occurs should be scrutinizingly watched from hour to hour, and almost from minute to minute. The feet and legs should be examined by touching with the hand from time to time, and whenever a tendency to chilliness is discovered, hot bottles, hot water-bags, hot bricks, or warm flannels with some warm drink, which may be simple hot water, should be made use of until the normal temperature is restored. The temperature of the room should also be elevated. Patients are frequently lost in the latter stages of acute disease for want of attention to such simple precautions. The nurse may be ignorantly or carelessly trusting to the patient's diet, or to his medicine, or to the occasional dose of stimulant which she is directed to give him, whilst the invalid is all the while sinking for want of a little external heat. Such deaths occur at all times in the year, even in the middle of summer, but, of course, are much more frequent in the winter season. The fatal chill is most apt to occur towards early morning, at the period of the lowest temperature of the twenty-four hours, and at the time when the supporting influence of the preceeding day's food is nearly exhausted. Generally speaking, weak patients may be expected to suffer cold more in the morning than in the evening; the vital powers are lower at any rate, and if they be feverish at night with burning hands and feet, they are almost sure to be rendered by the process of reaction chilly and shivering in the morning.

An extraordinary confusion between cold and ventilation exists even

in the minds of many well educated people. It should always be remembered that to make a room cold is by no means necessarily to ventilate it, nor, on the other hand, is it at all necessary in order to ventilate a room to chill it. Yet many nurses on finding when they enter a room that the air is close will let out the fire, if there be one, thereby making the air still more foul, or will open a door into a cold room, which has perhaps one of its windows open, by way of improving the conditions of the apartment. The safest atmosphere for an invalid is that of a room in which there is a good fire and an open window, unless in very cold weather, provided, of course, that no draught blows upon the patient.

Nor must the nurse be too much afraid of the night air, which sometimes in cities is really purer than the atmosphere in the daytime. It is true that many persons suffer from the effects of having a window open near their beds at night, but it is the motion of the air, and not its nocturnal quality, that proves injurious to them. In the first place during sleep the human body is much more liable to take cold under the same exposure than during the waking hours; and secondly, the night air being actually colder, and the difference between the internal and external temperature therefore greater, the draught is often much stronger by night than by day. But when the patient is properly protected from draughts, as directed in chapter II, page 124, ventilation at night by open windows is vitally important. As a general principle an apartment ought to be aired with outside air if possible.

In laying down the rule that a primary object of a nurse in regard to ventilation must be to keep the air breathed by the patient as pure as the air outside, it must not be forgotten that everything in the room which can evaporate gives off effluvia into the air. Out of all damp towels which become dry in the room, the moisture goes into the patient's air.

This cause of air pollution should especially be guarded against in children's nurseries and in the lying-in chamber, where an infant's soiled diapers are frequently hung near the fire or warm air register, in situations which enable them to poison the atmosphere in the most effectual manner possible.

We often see a nurse who will, when the patient leaves his bed, but not the room, open the sheets wide and throw the bedclothes back, in order to air the bed. Also she will spread the wet towels or flannels out carefully upon a clothes-horse for the purpose of drying them rapidly, and she does this perhaps with the best intentions, forgetting that all this dampness and effluvia is only afforded a better chance to enter into the patient's system through his lungs, and perhaps in his already weakened state do him a serious injury. The evil influence of effluvia from discharges from the bowels and the kidneys should be particularly guarded against, as is *not* usually done by nurses. In many cases concealing the chamber utensils beneath the bed, or in a commode, seems to be all that



is thought necessary for safety. The use of any such utensil without a lid should be utterly abolished, whether among sick or well. The importance of this absolute rule is shown by examining the under side of the cover of such a vessel an hour or so after it has been used and remained unemptied. It will nearly always be found coated on its under surface with offensive condensed moisture, which would but for the lid have been given off into the atmosphere of the room to be breathed by the patient and others occupying it. A slop-pail should never be brought into a sick room; it should be made an invariable rule that the utensil should be carried, directly after it has been used, to the water-closet, emptied there, rinsed there, and brought immediately back. Fumigations and disinfectants are not to be depended on for purifying the air. It is the offensive thing, and not the smell, which must be removed or destroyed. Moreover, it should not be forgotten that old dirt is just as bad sometimes for the sick as fresh dirt. Old papered walls of many years standing, dirty carpets, and uncleansed furniture, are just as ready sources of impurity to the air as a dung-heap in the basement, or under the bed in a chamber utensil.

The proper making up of the bed has much to do with the comfort of the patient, and in case of fractured limbs its arrangement is of the utmost importance. A well stuffed hair mattress, about six inches thick, or a good spring mattress, is the best for a majority of patients. If the illness is likely to be protracted, a wide strip of gum or oil-cloth should be placed over this, in order to prevent it from absorbing discharges, and becoming foul or ill-smelling. The greatest care should be exercised to keep the under sheet, upon which the patient lies, smooth and free from crumbs and other irritating particles, as there is nothing more trying to the patient, or more likely to give rise to troublesome sores, than wrinkles in the sheet, or hard, sharp crumbs neglected from successive meals. Nurses should make a daily effort to arrange the amount of bed-clothing in accordance with the daily temperature and moisture of the air, as well as in particular cases with the special needs of individual patients. It is often a great comfort to an invalid to have his mattress changed once or twice a week if he is long confined to the bed, and there are few cases, except those of fracture of the thigh, which cannot be moved from one mattress to another with safety.

In regard to washing patients, a nurse should see to it that the patient have his face and hands washed every morning, his feet bathed at least twice a week, and in addition, unless there is some objection to it, that he should have a warm bath at least once in every seven days. Many patients are, of course, able to attend to this for themselves, but in every instance it should be the nurse's duty to see that it is done efficiently, as there is little hope of progress towards recovery in a case where disease is assisted by dirt.



All the body linen of patients who are confined to the bed should be changed at least once a week, and if possible more frequently. The changing requires some little care on the part of the nurse, and especial attention should be paid to the following points: First, never begin to change the clothing of a patient until you have all that is likely to be required in the operation entirely ready; second, be careful that there is no draught blowing on the patient from some neighboring door or window; third, let the fresh linen be properly aired and warmed beforehand; fourth, do not move nor uncover the patient more than is absolutely necessary; fifth, if the patient is willing, but feeble, be very careful that he does not help too much and so exhaust his strength, which will be severely taxed by the process.

Feeding patients is generally acknowledged to be the special province of the nurse, and in many cases the recovery of a sick man from a dangerous illness is due to the steady regularity with which the nurse has attended to each turn of a capricious appetite, and has opportunely administered food in the form most palatable at the moment. A very important part of the nurse's duty, also, is to see that patients have what is ordered for them by the medical attendant, and that only, so that they shall not make themselves ill with unsuitable food, introduced into the sick-room by the ill-judged kindness of mistaken friends. Thousands of patients are every year starved in the midst of plenty for want of attention to the ways which alone make it possible for them to take food.

This want of care is as remarkable in those who urge upon the sick to do what is quite impossible for them, as it is in the invalids themselves, who will not make the effort to do what they can perfectly well in order to sustain life. For instance, the large majority of weak patients find it quite impossible for them to take any solid food before eleven o'clock in the morning, nor even then if their strength is still further exhausted by complete fasting until that hour. Weak patients generally have feverish nights, and in the morning consequently dry mouths, which make it neither easy nor useful for them to try to eat solid food. But by giving them a spoonful of beef-tea, of wine and arrow-root, or of beaten-up egg every hour, they are usually able to absorb the necessary nourishment to prevent them from being too much exhausted at a later period of the day, when the fever leaves them capable of swallowing and digesting the solid food indispensable perhaps for their recovery. Every patient who can swallow at all, can swallow these liquid articles of diet if he chooses, but in many instances it is physically impossible for a patient to eat for breakfast the solid food which is recommended. It is not unusual to see in very debilitated patients serious consequences arise from the ten minutes fasting, on the one hand, or repletion, as it may be called, on the other, due to the nurses want of punctuality in administering food. In many weak patients there is often a nervous difficulty of swallowing, which is

so much increased by any other call upon his strength, that unless they have their food punctually at the minute, which instant must be so arranged as to conflict with no other moment's occupation, they can take nothing until the next respite occurs, so that an unpunctuality or delay of ten minutes may easily turn out to be one of two or three hours, during which fatal prostration perchance occurs. Even in chronic cases life literally hangs sometimes upon such minutes, and there is great danger that whilst these matters are carefully watched in sudden accidents or violent illness, in more prolonged sickness their importance may not be appreciated. Still more is this true in chronic cases lasting over months and years, where the fatal issue is often determined at last by mere protracted starvation, and yet a little ingenuity and a great deal of perseverance would probably have averted that result. The careful examination as to the hours in which the patient can take food, the observation of the times, often varying with external circumstances, when he is the most faint, and the altering of the periods for administering food so as to anticipate, and thus prevent, such paroxysms of weakness, although requiring those high qualities of observation, ingenuity, and perseverance, in an eminent degree, which go to make a good nurse in the true sense of the word, are extremely important and such care would doubtless save a vast number of lives which are now wasted. Often to leave a patient's untasted food by his side from meal to meal, in the vain hope that he will eat some of it in the interval, is simply to prevent him from taking any food at all. Let food come at the right time and be taken away at the right time, eaten or uneaten, but never let an invalid have something standing by him, unless it is desired to disgust him with all forms of nourishment. A patient, if possible, should not see or smell the food of others, or a greater amount of his own food than he himself can consume at one time, or even hear food talked about, or see it in the raw state. The more an invalid can be alone whilst he is taking food the better, and even if he must be fed, his nurse should not allow him to talk, or talk to him, especially about food, whilst eating.

The injurious effect of noise upon sick people should never be lost sight of by a nurse. Of course, no attendance can be absolutely noiseless, but unnecessary noise, or noise that creates an expectation in the mind, is what hurts a patient. If any disturbance of the brain, which is almost always accompanied by more or less headache, exists, the slightest sound is often painful; but even here intermittent or sharp noises, and especially noise with a jar of the room, is particularly distressing. Whatever wakes a patient suddenly out of his sleep will invariably put him in a state of greater excitement, and do more serious mischief than almost any continuous noise, however loud. Patients are very frequently made worse by the consciousness that there is a whispered conversation concerning them going on just outside the door of their room, and a whispered con-



versation in the same room is absolutely cruel, because it is simply impossible for the patient, especially if in an excited condition, not to strain his ears to hear what is said. Walking on tiptoe, or doing anything in the room very slowly, is injurious for the same reason. A firm, light, quick step is by far the most desirable. A good nurse will be careful not to wear a rustling dress, creaking or clattering shoes, or a bunch of keys that rattle; she will guard against the creaking of a door, the rattling of a window, or the flapping of a blind or curtain, especially when a patient is ready to compose himself for the night.

Visitors to the sick should bear in mind that all hurry and bustle is peculiarly painful in illness. The friend who remains standing and fidgeting about whilst a patient is talking business to him, or the friend who sits and prosés,—the one from an idea of not letting the patient talk, and the other from an idea of amusing him,—are equally injurious to the invalid. A good rule is always to sit down when a sick man is talking business to you, show no signs of hurry, give complete attention and full consideration if your advice is wanted, and go away the moment the conversation is concluded. It is important for a visitor always to sit in a patient's view, so that when you speak to him he is not compelled to painfully turn his head around whilst answering you. If you make this act a wearisome one on the part of the patient, you are doing him harm. Never speak to an invalid from behind, nor from the door, nor from a considerable distance off, nor whilst he is engaged in doing anything.

Noises at night overhead, or in neighboring apartments, and to a less degree underneath a sick man's bedroom, are particularly objectionable, and as they are usually made thoughtlessly and carelessly, can be generally guarded against by sufficient watchfulness on the part of a nurse.

### COOKERY FOR THE SICK.

Scrupulous cleanliness is always necessary in the kitchen, but in a sick-room it is absolutely indispensable. The senses of smell and taste of an invalid are often morbidly acute, so that it is very important to be sure that every utensil used in preparing or serving food, whether saucepan, spoon, or feeding-cup, is absolutely free from any taint of whatsoever has previously been contained in it. All cups or dishes, especially those which have contained milk, should be thoroughly cleansed with very hot water and soap before being used again. A nurse should never forget that the manner in which food is served has a marked effect upon the way in which it will be accepted by a sick person. It is much better to offer an invalid too little than too much of an article of food, no matter how desirable it may be for him to partake of it freely. There is nothing so disheartening or nauseating to a patient as to have presented to him an abundant meal which would frequently



be more than enough for a person in good health. An ounce or two of meat, nicely minced and served up hot, with a sprinkling of salt and a mashed potato if not too large, will often be accepted where a slice of meat, which involves the trouble of cutting up, would be turned away from in disgust.

**BEEF TEA** may be prepared in either of two ways, which both give a fluid containing a large amount of the nutritive material in the meat. The beef should be divided up into small fragments by slicing it into a fine hash, and all lumps of fat should be removed. It should then be placed in a jar containing cold water, in the proportion of one pint of water to every pound of meat. Let this mixture stand for an hour, and then place the whole in an oven, or if this is not convenient in a saucepan half full of water, and putting it on the stove, let the water in the saucepan boil gently for another hour, then strain through a cotton cloth, and flavor to the taste. When beef tea is wanted in haste, it may be rapidly prepared by placing a jar containing the meat, finely divided, as before directed, but without any water, in an oven for about twenty minutes, and then adding boiling water in the proportion before stated.

**MUTTON BROTH** may be prepared by selecting the lean part of necks and loins, cutting it up into small pieces, and removing all superfluous fat. A pound of the meat, thus sliced, should be placed in a saucepan containing a pint of cold water. Next put it on the fire, and take off the scum which rises to the top. When this ceases to come up, let the broth boil undisturbed for about two hours, strain, and flavor to the taste. Some patients like to have a tea-spoonful of pearl barley added in the course of the preparation, as, for example, just as the broth begins to boil.

**CHICKEN BROTH** is prepared by putting the parts of the fowl allowed for the purpose in cold water, in a saucepan, using about the proportion already directed of a pint of fluid to a pound of meat. The whole is then to be gradually brought to a boiling temperature and permitted to boil for two hours, skimming off the superfluous fat.

**CHICKEN PANADA** is made by rubbing up together, in a mortar, the meat from the breast and wings of a roasted or boiled chicken, with an equal bulk of stale bread; then adding gradually the water in which the chicken has been boiled, or other broth; finally boiling for a few minutes and forcing it through a fine sieve.

**MEAT JELLY.**—Take one pound each of rump steak and lean mutton, cut them up fine, and put them in a jar which is to be covered and tied down tightly. Then place the jar in a saucepan half full of water, and let it simmer gently for three hours over the fire. Press the meat thus boiled soft through a sieve, and add to the essence half an ounce of isinglass, dissolved in a quarter of a pint of water. Set aside to harden, and when cold take off the fat. Another mode of preparing this nourishing jelly is to take a pound each of beef and veal, and boil them in a close

jar, as above directed, for four hours. If found too thick, from evaporation, at the end of this time, add a little water and then strain into a mould.

**PORT-WINE JELLY** is made by dissolving half an ounce of isinglass in a wine-glassful of water, with a couple of lumps of sugar, heating it gently for the purpose in an oven, or over a gentle fire. Then add five wine-glassfuls of port wine, and stir continually for ten minutes. Strain through muslin, pour into a mould moistened with a little clean, cold water, to prevent it from sticking, and set aside to cool. A piece of the size of an egg may be taken two or three times daily. If preferred, a little nutmeg or cinnamon may be grated into the wine before adding it to the isinglass. Another method is to take half a pint of port wine, an ounce of isinglass, a quarter of an ounce of powdered gum arabic, and an ounce and a half of brown sugar candy. Mingle these together, and let the mixture stand over night. Then warm, without letting it boil, until the ingredients are dissolved.

**BEEF-TEA CUSTARD.**—Beat up the white of one egg with the yolk of two and a little salt; add a small wine-glassful of beef tea strained through a cloth; mix and pour the mixture into a cup, lightly buttered; tie it over, and set in a pan of boiling water, taking care that the boiling water in the vessel comes up to the same level as the contents of the jar.

**CALVES-FOOT JELLY.**—Thoroughly cleanse two calf's feet, cut them into pieces and stew them in two quarts of water, until reduced to one quart; set aside to cool, and when cold, take off the fat and separate the jelly from the sediment; put the gelatinous portion into a saucepan, with white wine, brandy, and flavoring to the taste, throw in the shells and whites of four eggs, mixed together, boil for a quarter of an hour, cover and let stand for ten minutes, and finally strain, whilst hot, through a flannel bag into the mould.

**AN OMELETTE** may be either sweet or savory, according to the flavoring which is added; otherwise, the preparation is the same in both cases. Place a piece of butter or lard the size of a walnut in a clean frying-pan over the fire, and whilst it is melting, break an egg into a cup containing a table-spoonful of milk, and mix well together with a fork, adding the flavoring—either sugar or salt, pepper, parsley, and so forth—as required. When the fat is hot enough, pour the egg mixture into the middle of the pan, and keep a constant though gentle agitation of the utensil all the time the omelette is being cooked, that is, for about five minutes, to prevent the egg from sticking to the bottom. When done, roll together in the form of a pancake, and serve up quickly.

**BRANDY AND EGG MIXTURE** is made by beating up an egg, or if it be desired to make the preparation lighter and more digestible, the yolk of an egg only, with some powdered sugar, then adding gradually a wine-glassful of cold water, stirring carefully all the while, and finally mixing in a wine-glassful of brandy.

**WHITE-WINE WHEY** is made by adding a wine-glassful of sherry to half a pint of boiling milk, pouring the curds and whey which result on a strainer, and serving whilst hot.

For **GRUEL**, mix two table-spoonfuls of oatmeal into a very smooth paste with a little cold water. Then add it slowly to half a pint of water, put it on the fire and boil for a quarter of an hour, stirring constantly. Lastly, flavor with lemon-peel, sugar, nutmeg, and so forth, according to the taste, and strain through muslin whilst hot.

**SAGO** requires to be soaked a little while before using. An ounce should be put into a pint of water, and allowed to stand on a stove or in an oven for two hours; it should then be boiled for a quarter of an hour, and flavored to the taste.

**ARROWROOT** may be prepared with either milk or water; but if it is desired to add wine or brandy to it afterwards, water is preferable in its composition. A table-spoonful of the arrowroot should first be rubbed up into a smooth paste with a small quantity of water, and then a pint of boiling water poured slowly over this, stirring constantly until it is of the consistence preferred. It should then be boiled up for five minutes, sweetened with a few lumps of sugar, and a little nutmeg grated over the top; instead of nutmeg, lemon-juice, or essence of bitter almonds, may be added.

**TAPIOCA** may be prepared in exactly the same way as sago, with the exception that being more soluble in water, half the time is sufficient for the preliminary soaking.

**ARROWROOT PUDDING** is prepared by adding the yolks of two eggs to half a pint of boiled arrowroot, made as above described, with a tea-spoonful of powdered white sugar. Mix thoroughly and bake in a lightly buttered dish for some ten or fifteen minutes.

For **CUSTARD PUDDING**, break an egg into a tea-cup, and mix thoroughly with sugar sufficient to sweeten it to the taste; then add milk enough to nearly fill the cup, mix again, and tie over with a small piece of linen; lastly, place the cup thus prepared in a shallow sauce-pan half full of water and boil for ten minutes. If it is desired to make a light batter pudding, a tea-spoonful of flour should be stirred into the above mixture before tying it up for boiling.

**RICE-BLANCMANGE.** Simmer half a pint of milk with a table-spoonful of pounded or granulated white sugar until near boiling, then stir in two ounces or about one large table-spoonful of ground rice, previously mixed with a half a pint of milk until smooth; boil the mingled liquids for ten minutes, stirring all the while, pour into a moistened mould, and serve up when cold.

**ICELAND-MOSS JELLY.** This variety of moss contains a bitter principle from which it should be freed before it is used as an article of diet. For this purpose pound it after it is thoroughly dried, and soak it in warm



water along with a little bi-carbonate of soda, say a tea-spoonful to the pint, for twenty-four hours, after which squeeze dry in a coarse cloth. Add an ounce of the moss thus prepared to a quart of water, and boil the mixture down to one half its bulk. Strain the resulting jelly through a sieve, and sweeten or acidulate, or mix with milk, according to the taste of the patient.

IRISH-MOSS JELLY is made by boiling an ounce of Carrageen or Irish moss in a pint and a half of water down to a pint, straining, and sweetening or flavoring as may be desired.

LEMONADE may be prepared by paring a lemon very thin, shaving away as much of the white substance under the skin as possible, cutting the fruit into thin slices, and putting them with the parings of the rind into a pitcher with about their bulk of white sugar; then add a pint of boiling water, let stand until cold, and lastly, strain off clear.

FOR BARLEY-WATER, take two ounces of pearl barley, and having twice washed it in cold water, boil it for twenty minutes in a pint and a half of water. Strain, and flavor with sugar, lemon-peel, and so forth, to the taste.

TOAST-WATER OR CRUST-COFFEE is made by taking a slice of stale bread or bottom crust of a fresher loaf, toasting it carefully without burning or smoking it, putting it into a bowl or pitcher, and pouring over it a pint of boiling water. This is usually drunk cold, and often seems to quench the thirst in fevers without producing vomiting so readily as pure water.

FLAXSEED TEA. This famous and really excellent remedy for a bad cold should be made by pouring a pint of boiling water over half an ounce of unbruised flaxseed and a dram of extract of liquorice, that is, the ordinary black liquorice, contained in a covered jar. The infusion thus commenced ought to stand on the stove, or near a fire where it will keep hot without approaching the boiling point, for three or four hours, after which it should be strained and flavored with lemon-peel or some extract for which the patient may entertain a preference.

RICE-WATER is made by washing on a strainer with cold water an ounce of rice, which is then put into a stew-pan with an inch of stick cinnamon and a pint of boiling water, boiled for an hour, then strained and sweetened to the taste.

The above are a few of the important recipes used in cooking for the sick; for a more extensive consideration of the subject consult page 1015.

### ENEMAS OR INJECTIONS.

An ENEMA, the plural of which is, correctly speaking, enemata, of opium, or laudanum injection, consists of two fluid ounces of thin boiled starch, made about the consistence of thin molasses, and from twenty to forty drops of laudanum. It is, of course, to be retained altogether if possible,

or as long as the patient can prevent it from coming away, and affords one of the most soothing remedial measures for any irritation in the intestines, bladder, kidneys, or other organs contained in the abdominal cavity, which can be employed. Sometimes it will be borne by patients where suppositories, which are its almost exact equivalent, excite the bowel to expulsive efforts, and are rejected before they have time to melt, and consequently to have any beneficial effect. Otherwise opiate injections, being more troublesome and less cleanly than anodyne suppositories, have been largely superseded in practice by the latter wherever they can be procured.

BEEF-TEA INJECTIONS for the purpose of nourishing the patient, as, for example, in cases of ulcer of the stomach, may be made by mixing from four to eight ounces of strong beef-tea with an ounce of cream, and half an ounce of brandy should stimulation be required. If this causes any irritation of the bowel, the addition of a couple of ounces of starch and five or ten drops of laudanum will often remedy that difficulty.

Barley-water, which is often used as a vehicle for active remedies given by injection, is made as already directed, except, of course, that the flavoring must be omitted.

A COMMON-SALT INJECTION may be made of an ounce of salt in three-quarters of a pint of barley-water or gruel.

A SOAP INJECTION consists of an ounce of soft soap and three-quarters of a pint of hot water, which are to be rubbed together until completely mixed, and injected warm.

AN ENEMA OF CASTOR-OIL AND TURPENTINE is composed of an ounce and a half of castor-oil, half an ounce of oil of turpentine, called usually the spirits of turpentine, thoroughly mixed up with twelve ounces of barley-water or gruel.

FOMENTATIONS of laudanum or turpentine are prepared by dipping pieces of thick flannel in hot water, wringing them out moderately dry, and then sprinkling over the surface which is to be applied to the skin half an ounce or an ounce of laudanum, or of spirits of turpentine. The flannels thus charged with the remedies are to be put on hot, and covered with oiled-silk or other waterproof material. They may be changed as often as they grow cool, if reapplication continues to afford relief to the patient.

Enemas are used for very many purposes and may be either purgative, sedative, or soothing, stimulant or nourishing, such as those above directed. The method of administration is as follows: The patient should lie on his left side close to the edge of the bed, with his knees drawn up, the basin containing the substance to be injected being placed on a stool or chair by the side of the couch. The nurse, then standing behind the patient, should gently pass the nozzle of the syringe, previously well-oiled, and in cold weather warmed by immersion in hot water, through the

fundament, and for three or four inches along the bowel, directing the point at first backwards toward the spine and then a little forwards. On no account whatever is force to be used to overcome any obstruction that may seem to exist to this introduction. The injection should be made slowly, with a moderate amount of pressure only, and must be stopped the instant the patient asserts that he cannot bear any more. For nourishing enemas, from four to six ounces, or from a quarter to one-third of a pint, are sufficient, as they are, of course, to be retained as much as possible. For cleansing purposes and as laxatives, from one to two pints, or even more, may be employed. In invagination of the intestine several quarts of warm water may be slowly injected if endurable.

SUPPOSITORIES are generally used either to relieve pain or for astringent effects. The suppository which is to be administered should be got ready by placing it in a cup of ice water for five minutes, so that it shall not melt in the preliminary handling. If the patient is not able to help himself, the nurse must introduce the remedy as follows: The invalid should lie on his left side, and the nurse, standing behind him, should pass his hand under the bedclothes to the fundament, and then telling the patient to bear down, must at the same moment slip the suppository into the anus, and push it up with the tip of the finger about half an inch, so as to get it beyond the sphincter, which would otherwise perhaps throw it out again. As soon as it is in place, tell the patient to stop bearing down and to make, on the contrary, every effort to retain the suppository.

The administration of medicines should be regularly and systematically performed, and the exact quantity ordered ought to be accurately measured with a glass measure, as even a slight error may lead to serious consequences, if often repeated. The glass spoon or cup which has been used for one kind of medicine or one patient, must be thoroughly cleansed before being employed for another.

It is well to make it an invariable rule always to hold up to the light and inspect, then smell, and finally taste a medicine *before* administering it to a patient. This practice would, of course, involve some trouble and personal inconvenience, but if universally adopted, would almost certainly prevent the occurrence of those lamentable cases of accidental poisoning which are so common and so deplorable.

A separate measure should be kept for oily or strong-smelling medicines, such as castor oil or cod-liver oil, valerian or assafoetida, since it is impossible to get rid of the odor of these drugs by simple washing. Powders are conveniently given either mixed with a little honey or milk, or made into a paste with fruit jelly, honey, or molasses. If a patient is unable to take pills, they should be mashed up in a little jelly and washed down with a draught of water. Generally, however, if they are placed well back in the mouth upon the middle of the tongue, they go down perfectly well with a spoonful of some bland liquid, such as flaxseed tea,



or even a little bread and milk, even though taking them in the usual way with a sup of water seems to the invalid an impossibility.

When a person absolutely refuses to take medicine, the nurse is sometimes obliged to administer it by force. This does not often happen, however, except with children, especially of the spoiled variety, who, although never found at home, are so common in others' houses. In such a case, the head should be held firmly by one or more assistants, and then the nurse should close the nostrils of the refractory patient with one hand, and as soon as the mouth is opened for breath, should quickly pour the medicine into it from a spoon held in the other. If it is spit out, the same process should be gone over again, and repeated until in the end perseverance conquers obstinacy. If a medicine appears to the nurse to be producing any marked symptoms in a patient,—such as vomiting, diarrhoea, pain in the stomach, headache, drowsiness, convulsive movements of the muscles, or running at the eyes, nose, and mouth,—it should be diminished in quantity, or altogether omitted until after further instruction from the physician.

THE USE OF THE CLINICAL THERMOMETER.—So much information can be gained by observation of the bodily temperature, especially in children, that every family should be provided with this little instrument, which ought to be systematically used in all cases of threatened or developed disease. The best place for testing the temperature of a patient is the armpit, and care should be taken that the thermometer comes in contact with the bare skin, both of the inner side of the arm and of the wall of the chest. The instrument ought to be hugged up closely by the patient for at least five minutes, and unless it is self-registering, must be examined before it is moved, and even then the stem uncovered as little as possible. The usual temperature of the human body is  $98\frac{1}{2}^{\circ}$  Fahrenheit; but the heat in diseased conditions may rise to  $108^{\circ}$  or even  $109^{\circ}$ , this latter being, however, an almost certain indication of a fatal issue to the malady. Patients do not often recover after a temperature of  $107^{\circ}$  has been maintained for even a few hours, and about one-half die among cases in which a long-continued heat of  $106^{\circ}$  is met with. When a rapid rise of temperature, as determined by the thermometer, has occurred, we may generally look for an equally rapid fall and speedy decline of the complaint. On the other hand, the gradual elevation—as in typhoid fever, when three or four days are usually occupied in attaining a bodily heat of  $104^{\circ}$ —indicates a prolonged malady, at the termination of which a similarly gradual descent is apt to attend the decline of the complaint. The diminution of the fever heat in the morning, and its rise each day to a point a degree or so higher than at a corresponding hour on the preceding evening, is so characteristic of typhoid fever during its first week, that, as stated on page 329, a diagnosis of the malady may sometimes be made by an expert physician on a single glance at the record of

temperature, in an otherwise obscure febrile disease. Such a temperature record is so valuable, not only in the diagnosis, but also in the prognosis and treatment, of most human maladies, that it would be well to have it kept in all serious cases upon the "temperature sheets" sold by medical booksellers for the purpose. Many an anxious mother might be saved from needless apprehension about her children, when they are but slightly feverish, if she would observe their temperature with a thermometer; and, on the other hand, careful thermometric observations would often give warning of threatened illness, or of grave complications arising during sickness, in time to call in skilled medical assistance, and so save a valuable life.

The application of LEECHES, though not often called for, is sometimes necessary for removing a small quantity of blood from a locality to which cups cannot be applied, as, for instance, from an inflamed knee-joint, or from the scalp. They should never be induced to bite directly over a large vein, for fear of inflammation or troublesome bleeding. Usually, all that is required is simply to lay them upon the part from which the blood is to be drawn, after it has been washed clean, confining them to the required spot with a pill box or small glass until they bite, and then letting them remain until they fall off gorged with blood. If it is desirable to promote bleeding, the bites should then be fomented with warm, moist flannels, or a piece of spongio-piline laid over them after it has been dipped into hot water. The quantity of blood drawn by one leech varies with the kind of worm made use of. About a dram of blood will be extracted by a leech of the common variety, but the large Spanish leeches draw from half an ounce to an ounce, and this amount may be doubled or quadrupled by faithful fomentation of the part subsequently. If the leeches are disinclined to bite, their appetite may be stimulated by moistening the part with a little milk, or sugar and water, or still more certainly with a drop of blood drawn for the purpose by pricking the finger. The bleeding from a leech bite, if excessive, can generally be stopped by firm pressure with the finger. If this is unsuccessful, a little powdered or burnt alum may be applied, or the wound may be touched with caustic. Leeching ought to be reluctantly resorted to in houses, neighborhoods, or seasons of the year in which erysipelas is prevailing, on account of the danger that erysipelatous inflammation of the bites may follow.

CUPPING might, it is probable, be employed much more frequently with advantage than is at present the custom in medical practice. Cut-cupping is a painful operation, but dry cups may be put on with only a little discomfort, and would often afford great relief. In the absence of cupping apparatus, in which the requisite vacuum is produced by the aid of a small air-pump, the operation can be performed with egg-glasses or small tumblers, into each of which is thrown a scrap of paper about two inches



square, which is lighted after being dipped in alcohol. This rarefies the air in two or three seconds, and when applied to the body is immediately extinguished by the resulting deprivation of oxygen. Care must, of course, be taken not to set fire to the patient, or unnecessarily add the remedial measure of blistering to that of cupping.

BLISTERS are made of different shapes and sizes according to the object desired. The blistering cerate may be spread upon paper, muslin, or sticking-plaster, and the usual time for drawing varies with the thickness of a patient's skin, but on an average from six to twelve hours must be allowed. An easy way of managing a blister is to remove the plaster as soon as the skin is seen, by raising up one corner, to be decidedly reddened, and then covering the surface with a bread-and-milk poultice, or with a soft linen rag thickly spread with simple cerate. When the skin over the blister is properly raised up by the effused liquid underneath it ought to be cut in several places with the sharp points of a pair of scissors, and the water, as it drains off, caught in a slightly moistened cloth, since it contains enough of the active principle of the cantharides to blister any surrounding sensitive parts with which it is allowed to remain in contact. As much as possible of the old epidermis is to be preserved as a temporary protection for the raw surface beneath, and the whole may be covered with a fresh piece of linen thickly spread with simple cerate, unless the blister is to be kept open, in which case some irritating application, such as the bazilicon ointment, is generally used. The simple cerate dressing should be renewed twice daily, and under it the sore generally heals within a week, unless it is of a very large size.

POULTICES may be applied on paper, linen, or cotton cloth, or what is a neater and cleaner method, sewed up in a flat bag of linen or muslin.

BREAD POULTICE should be made by first grating a sufficient quantity of stale crumbs of bread; this should be added to boiling water in a dish or basin, carefully stirring until the consistence of a thick paste is attained, and the resulting mush-like mass poured out upon the muslin or other material prepared to receive it. A bread-and-milk poultice should be prepared according to the same method, substituting boiling milk for water. On the surface of the poultice intended to come in contact with the skin a tea-spoonful of laudanum may be poured if the object is to relieve pain. When used upon hairy portions of the body, poultices should always be enclosed in a bag, or at least covered with some thin fabric, such as a cambric handkerchief, folded closely around the edges before being applied.

A FLAXSEED POULTICE may be prepared by pouring a quarter of a pint of boiling water into a previously warmed basin or large cup, and then adding, gradually, enough of the flaxseed meal to form a thick paste, stirring thoroughly all the time. If the poultice is to remain on for several hours, it is well to add a little simple ointment or olive oil, mixing



this in also very assiduously. The object of this oleaginous ingredient is to prevent the poultice from becoming dry, hard, and therefore mechanically irritating. Sometimes, a little oil or ointment smeared around the edges of the poultice just before it is applied answers this purpose perfectly well and adds greatly to the comfort of the patient, particularly if it is left on all night.

**MUSTARD POULTICES OR PLASTERS.** The method of making mustard poultices varies with the honesty of the corner groceryman, and with the amount of counter-irritation desired. If the mustard is pure, and the irritation is intended to be severe, a sufficient bulk of the flour of mustard is mixed with boiling water into a paste, and then spread in a thin layer upon brown paper or muslin, which is to be covered with muslin or linen folded in at the margins, so as to make the poultice of the required size. For persons of sensitive skins, or for mild counter-irritation, mustard flour diluted with one-half or three-fourths its bulk of flaxseed meal, or "pure mustard" from some reliably dishonest dealer, should be mixed into a paste, and employed in the same way.

A **CHARCOAL POULTICE** is prepared by soaking two ounces of bread-crumbs for ten minutes with half a pint of boiling water in a vessel placed near the fire, mixing in thoroughly an ounce and a half of flaxseed meal, and afterwards a quarter of an ounce of powdered wood charcoal. Spread as directed for an ordinary poultice, and finally sprinkle another quarter of an ounce of charcoal over the surface which is to come in contact with the patient's skin.

**CARROT POULTICES** are made by boiling the roots until they are quite soft, then mashing and straining them through a sieve, and applying whilst hot.

For an **YEAST POULTICE** take six ounces of brewer's yeast, and mix it with an equal quantity of hot water; then stir in a pound of flour or fine oatmeal, and let it stand in the pan or basin near the fire for some hours until it rises. It is to be placed on a cloth, or better, put into a bag, and applied as directed for a bread poultice. An yeast poultice is sometimes wonderfully efficacious in hastening the removal of the core from a carbuncle, boil, or felon upon the hand.

## CHAPTER XVIII.

# CONVALESCENCE.

SINCE convalescence is the termination to which a strict obedience to all the instructions contained thus far in the volume would naturally lead, except in cases of local or general old age, for which no cure has yet been discovered, a few remarks upon it may appropriately conclude the sections devoted to preventive and curative medicine.

When a malady is terminated, sanitary science, which had previously labored in conjunction with therapeutics to extinguish the morbid tendency, resumes sole charge of the patient, and directs the convalescence, during which the individual, although no longer sick, is not yet in a state of perfect health. In convalescence, the functions, although brought to an equilibrium, are still wanting in energy and in stability; the entire organism, more or less shaken by the attacks to which it has been subjected, reëstablishes itself slowly, and, as it were, step by step, in its connections and its reactions with the external world.

Convalescence presents some very different characters according as it succeeds to acute or chronic affections. In the former case it is clearly defined even to a superficial observer. Often its commencement is marked by critical phenomena, and always by the cessation of local pains or general symptoms of the disease. To the patient himself it announces its welcome advent by a feeling of ease and comfort previously longed for in vain; whilst to the physician it makes itself known by reliable characteristics, such as a natural and peaceful expression of the countenance, vivacity and clearness of the glance, susceptibility, and, as it were, curiosity of the senses, an agreeable change in the disposition, and a tendency to gaiety, a prolonged and refreshing sleep, and a great mobility of the circulation. From this last peculiarity arise alternatives of pallor, and flushing of the face from slight causes, or pleasant moisture and softness of the skin, and an excessive sensitiveness to cold. Further indications of favorable convalescence from acute disease are an increased freedom of respiration, an eager or sometimes ravenous appetite, moisture and cleanness of the tongue, softness of the abdomen, and a decided tendency to constipation.

Of course, these encouraging signs do not all make their appearance simultaneously, but they generally follow in groups at short intervals. Almost always the first phenomena of returning health develop them-

selves amidst the fading evidences of illness, but occasionally we observe, in individuals of vigorous constitution, transitions from disease to convalescence occur with marvelous rapidity. In recovery from chronic maladies the physician is not often called upon to assist at such kaleidesopic changes from disease to health. The functions of the organism do not reëstablish themselves with the same promptitude, nor in the same almost simultaneous manner. They become regulated, as it were, one by one, in consequence of careful and individual attention, and even when restored to their physiological type, they are wanting for a long time in force and endurance. The loss of adipose tissue is often not repaired until after months or even years of convalescence, and the countenance frequently retains for a great while an imprint of the sufferings which have been endured.

If we consider the symptoms of convalescence a little more closely, we will find that hunger is one of the first and most important manifestations of returning health after an attack of acute disease. The appetite for food is sharp and renews itself in a very brief period; sometimes it is even voracious. Eating becomes in many cases the great, perhaps the sole, aim of the convalescent; and when he happens to be of an age when growth is not yet terminated, and when, consequently, assimilation is normally active, he is apt to seek the gratification of this voracity with arguments and supplications which render it very difficult for the physician or nurse to enforce a proper regulation of the diet. In military hospitals it is often necessary to resist the tears and most vehement prayers of convalescents in order to preserve them from dangerous and fatal consequences of their own excesses. We must, however, guard against a disposition to restrain the patient too much in regard to nourishment through an exaggerated fear of the effects which it may produce. It is essential to take into consideration the degree of appetite and the sensations which the convalescent experiences during the process of digestion. If the desire for food returns slowly and is capricious in its choice of articles of diet; if the patient is quickly disgusted and wishes to daily change his bill of fare; if, in eating, he does not experience the pleasure which accompanies the satisfaction of a real want of the organism; and if, during digestion, acid eructations, flatulence, flushing of the face, and distinct febrile movement occur, convalescence is not yet sufficiently advanced to permit gratification of the appetite, and diarrhœa is apt to supervene on such indulgence. Should it do so, whatever progress towards health had been made by the organism is often more than obliterated.

In convalescents the circulation presents a singular impressionability. The pulse is often slower than in health, falling sometimes as low as fifty, forty, or even thirty-five beats per minute; but it is accelerated by the slightest causes. Changing the attitude or position, the approach of a stranger, especially of the physician, and even a slight mental or moral



excitement, will greatly increase its rate. Palpitation of the heart is very common, and also easily produced. The pallor of convalescents arises, not by the emptiness of the capillaries, as was formerly believed, but from the diminution in the quantity of red-blood corpuscles, in consequence of prolonged disgust for, or mal-assimilation of, food. This diminution is determined by the ingenious hæmatimeter of Hayem and Næchet, and sometimes is so great that the number of red corpuscles falls from 5,000,000 in each cubic millimeter of blood, to less than 2,000,000 in the same quantity. This poverty of the red globules probably has important relations to the hypostatic congestion of the cheek upon which the patient reclines, the œdema of the ankles, and the general tendency to subcutaneous infiltration with serum, so common during convalescence.

During repose no difficulty in respiration is experienced, but any muscular efforts, and especially the attempt to ascend a hill, or even a short staircase, causes the convalescent to be soon affected with dyspnœa. This may be due to some remaining febrile action, but is probably often caused by the inability of the diminished red-blood corpuscles to carry sufficient oxygen to, and sufficient carbonic acid away from, the muscles thus brought into activity.

The renal secretion ceases to present the dense, high-colored, and strongly odorous character met with during illness, and becomes more abundant, paler, and less fully charged with uric acid than in health.

The appendages of the skin, at least the hair, eyebrows, and so forth, and, it may be, an outer layer of the epidermis, are frequently shed during convalescence; but this loss, as a rule, is only temporary.

In females, the menstrual discharges are reëstablished, and in males a marked activity of the sexual functions is generally observed during convalescence from acute illness.

The mental powers, both of perception and ratiocination, gradually return during convalescence, but for a long time have little endurance, and become easily fatigued on exercise. After a severe acute malady, such as typhoid fever, the intellectual faculties are often very slow in returning to their original integrity, and months, or even years, may elapse before the patient enjoys again his full mental vigor.

The muscular movements, too, for a long time, fail in that energy and precision which marks a state of complete health, and all the organs display an inability to react against, or to withstand, any of the innumerable outside influences with which mankind is surrounded, as they would normally do.

The sleep of convalescence loses the disturbed character which it had during illness, and becomes calm, tranquil, and refreshing.

Hygiene being the preëminently powerful agent in the management of convalescence, the following sanitary rules are worthy of particular attention:

1st. The convalescent should be protected with especial care against variations in temperature, from the baneful influence of cold air and of currents of air, and from the effect of moisture. In the condition of his system he is particularly apt to be affected by these agents, which may readily bring on either a relapse or some more or less serious complication.

2d. In order to secure immunity from such injury, he should be well protected by warm clothing, thicker and warmer than he has been accustomed to wear at the corresponding season of the year.

3d. Baths should be indulged in only near the end of the convalescence, when health appears to be almost fully established, and they should be very short. It is well to employ those of a slightly stimulating character, such as alkaline baths, bran baths, and so forth; and great precautions should be observed against the slightest exposure to draughts of air for some time after coming out of the water. During convalescence from diseases of the respiratory apparatus, baths should be strictly forbidden.

4th. The diet must be very carefully regulated, and the following rules rigidly adhered to: In the first place, proportion the amount and character of the nourishment, not to the hunger of the patient, but to the digestive power of his stomach. Instruct him to eat often and but little at a time, to chew the food very thoroughly, not only to secure its reduction to small particles, but also its complete admixture with the salivary fluid. And lastly, to choose those articles of diet which are adapted to the comparative feebleness and sensitiveness of the digestive organs, and as far as possible, also, those which gratify the taste of the individual.

There are a great many cases in which physicians and nurses gain more credit with a patient and his friends by a very minute attention to the diet during convalescence, than by the most skillful treatment of the disease throughout its course.

Of course, the kind and quantity of nutriment must vary with the nature and duration of the illness from which recovery is taking place.

As a general rule, however, a patient may begin with weak chicken or mutton broth, free from fat, and boiled rice, which probably represent the two great classes of nitrogenized and amylaceous articles of food in their most easily assimilated form; experiments upon St. Martin's stomach having shown, it may be remembered, that rice is digested in less time than any other substance of the kind, only requiring one hour. The rice may be substituted by tapioca, sago, or corn starch, made with milk, if these are more palatable, according to directions on a previous page. After from two to four days, if improvement continues, administer stronger soups, eggs very slightly boiled, calves-foot jelly, rice pudding, and toasted bread, or stale bread with very little butter. In the course of a week, the patient may proceed to a mealy roasted white potato, a tender mutton chop or tenderloin of beef, and light bread, not less than twelve hours old, with sweet butter in moderate quantity. It is much better,



and saves time for the invalid, to go up the *inclined plane* of diet (never to ascend this hill of difficulty by jumps) a little slower than is absolutely necessary, than to advance too rapidly and bring on a relapse. The surest guide is the condition of the tongue; should that unruly member have cleaned off, as it usually does when full, frank convalescence sets in, go on carefully and cautiously up the list given above to stronger and more nutritious articles of diet; but should it put on a coat of fur again, remember it is a sign of repugnance to such rich food as it has to help swallow, and quickly taking the hint, put the patient back on "slops" for a few days longer.

During the tedious convalescence which we sometimes watch so anxiously after prolonged chronic diseases, or after relapses from more acute attacks, visits to the invalid are capable of accomplishing great good if properly managed. Every care should be taken not to depress a patient who is slowly recovering by allusions to unfavorable terminations in cases similar to his own. A sick person does so enjoy hearing good news,—for instance, of a love and courtship which has a happy ending. Sick persons also intensely enjoy hearing of any material good, such as a positive or practical success of the right in their own neighborhood or country, or, indeed, in any part of the world.

They have had generally a surfeit of books, principles, precepts, and theories; so, instead of advising them about their convalescence, with advice which they have heard at least fifty times before, tell them of one benevolent act which has really succeeded practically—it will be like a day's health to them. It is hard for people who are well to understand how intense is the craving of invalids, who, with reanimated powers of thinking, are still cut off from active participation in the world's work and progress, to hear of good practical action even when they cannot yet partake of it. In many instances there is no better society for a convalescent than that of babies, or of other invalids who are also convalescent; but, of course, this association must be carefully managed so that neither party will suffer from it, which is perfectly feasible as a rule. If you think the air of the sick-room is bad for the infant, of course it is injurious to the invalid also; and efforts should be made to remedy the aerial impurity without a moment's delay. It enlivens a sick person's whole mental atmosphere to see "the baby," and a very young child, if unspoiled, will generally adapt itself wonderfully to the ways of a sick person if the time they spend together is not too long. A small pet animal is often an excellent companion for a convalescent patient, especially if confinement to the house, in consequence of unfavorable weather or complications of the original disease setting in, is unusually prolonged. A pet bird in a cage has sometimes proved the only pleasure, or, indeed, solace of an invalid shut up to the same room for weeks or even months. If such a pet can be fed, cleaned, and taken care of in every way, and perhaps



taught some of the little tricks which birds, squirrels, and even mice are capable of learning, and which prove such a source of pride to the trainer and entertainment to visitors, the patient should by all means be encouraged to undertake the task. By such devices many a weary hour has been whiled away, and the sick-chamber of lingering convalescence shorn of half its almost intolerable weariness.

During convalescence, the secretions and the excretions must be carefully watched over, and any excess or insufficiency be corrected as soon as practicable. Copious perspirations, which are very apt to occur from simple relaxation of the integument, may be checked by six or eight grains of quinine, or one one-hundredth of a grain of atropia, or by sponging with alum and whisky before retiring. If the renal secretion is rather scanty, the patient should drink freely of some bland fluid, such as flaxseed tea, toast-water, or gum-arabic water. Constipation should be overcome by injections, or by tonic laxatives, such as rhubarb, in doses of five or ten grains daily.

The first walks or rides should receive special attention, the convalescent being warmly clothed, a warm sunshiny day being selected, in accordance with rules given under meteorology on page 117, and the exposure being at first for only fifteen minutes, or half an hour at the furthest.

After an invalid is strong enough to leave the house, complete change of air and scene is one of the most potent contributors to an entire restoration to health. The patient, who has remained for weeks in nearly the same state growing neither better nor worse, will often wonderfully improve after a few days spent in the country or at the seashore. If the period of sickness has been passed in a room where the only view was of the backs of houses or of the fronts of those forming the opposite side of a street, how grateful and invigorating is the sight of green fields, shady groves, and sparkling streams at some sylvan retreat. By the ocean, too, vitalizing sea breezes frequently exert an almost magical power over a frame enfeebled by disease and restore to the languid convalescent his wonted vigor with astonishing rapidity.

Lastly, try to secure the patient against any intense mental emotion or intellectual excitement, which will be almost sure to react with unfavorable effect upon his enfeebled physical powers.



# Suburban Residence, showing Foundation, Drainage, etc.



A. Man hole with Fresh-air Inlet. B. Intercepting Trap. C. Drain imbedded in Concrete. D. Yard Drain. E. Soil-pipe carried above Top of House.  
F. Concrete Bed. G. Ventilating Damp-proof Course. H. Ventilating Grate. I. Bath-Room Fixtures.



# HEALTHY DWELLING-HOUSES

AND

How to Build, Ventilate, and Drain Them.

INCLUDING

THE ESSENTIALS OF A HEALTHY SITE; THE PROPER CONSTRUCTION OF THE  
BUILDING AND THE WAY TO PREVENT DAMPNES OF CELLARS AND  
WALLS; THE MOST APPROVED METHODS OF VENTILATING,  
HEATING, LIGHTING AND DECORATING THE HOUSE;  
THE VARIOUS SOURCES OF WATER SUPPLY  
AND ITS INTRODUCTION TO THE  
BUILDING; THE REMOVAL  
OF REFUSE MATTER;

AND THE BEST ARRANGEMENT OF

DRAINS, WATER-CLOSETS AND CESSPOOLS.

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ADAPTED TO CITY OR COUNTRY USE.

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BY

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OF PHILADELPHIA; AUTHOR OF "THE VITAL STATISTICS OF PHILADELPHIA,"  
ETC., ETC., ETC.



## INTRODUCTION.

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### **The Importance of House Sanitation.**

Few subjects are of more general interest and exert a greater influence upon health and comfort than the sanitary construction and arrangements of the home. It would therefore be supposed that what so intimately concerns the welfare of the individual would be the object of his closest scrutiny, and that a knowledge of the governing principles of house sanitation would be the indispensable possession of most persons. But such, unfortunately, is not the case. Errors in house sanitation are everywhere most common. They are not confined to the hovels of the poor, but are encountered in the abodes of those in comfortable circumstances, and even in the costly palaces of the rich. It is not uncommon to read of the ravages of disease in houses supposed to be healthy, and where the prevalence of sickness was unaccountable until a skillful investigation brought to light some serious defect in the drainage arrangements, or some local source of contamination of the water supply, or revealed a polluted soil, which had not been suspected because it had not been inquired into, but which had slowly and insidiously exerted a baneful influence upon the health of the occupants of the house. How seldom is it that the householder inquires into the character of the drainage of his premises with the view of guarding the health of his family from the dangers which are so commonly associated with defects in this most important particular of house construction! The conditions of the soil underlying and surrounding the house, the foundations and sanitary construction and arrangements of the dwelling, the water supply, ventilation, and the removal of refuse matters,—subjects which vitally concern the health of the individual,—rarely receive the attention their great importance demands. To the architect, builder, mechanic, and laborer are entrusted the details of our dwellings with a complaisance and confidence that would be looked upon as foolhardy and unpardonable in trivial matters of every-day occurrence. This apathy on the part of the people to questions which so deeply influence their health and comfort is the outgrowth of ignorance of the funda-



mental principles underlying the whole subject of the sanitary construction and arrangement of dwelling-houses; and it is the purpose in these pages to set forth these truths as clearly as possible, so that every one may fully understand what is essential to make his home healthy.

### **The Essential Conditions of a Healthy Habitation.**

The conditions necessary to insure a healthy habitation have been summarized by Dr. Parkes as follows:

1. A site dry and not malarious, and an aspect which gives light and cheerfulness.
2. A ventilation which carries off all respiratory impurities.
3. A system of immediate and perfect sewage removal which shall render it impossible that the air shall be contaminated from excreta.
4. A pure supply and proper removal of water, by means of which perfect cleanliness of all parts of the house can be insured.
5. A construction of the house which shall insure perfect dryness of the foundations, walls, and roof.

The great object to be attained in imposing these conditions is perfect purity of the air in and about the dwelling. The diseases which arise from defective habitations are due, for the most part, to impure air. Contamination of the air may be produced in a variety of ways. It may be due to an improper selection of the site. A malarious soil, or a soil charged with moisture or with organic or other impurities, derived, it may be, from leaking cesspools, defective drains, sewers, or gas-mains, or from the accumulations of refuse matter upon the surface of the ground, will give rise to emanations which may pass into the house and render it unhealthy. The construction of the house may be defective, no proper attention having been given to the selection of suitable materials for building, to the dryness of the roof, to the means of excluding dampness from the foundations, cellar floors, and walls, or to the arrangement of the rooms and passage-ways to insure the free circulation of air. The means of ventilation may have been ignored, and, in consequence, the air of the house becomes vitiated by the accumulation of impurities from the body and from other sources. The drainage of the house and the arrangement of the plumbing work and fixtures may be seriously at fault, allowing filth to exude and defile the soil or sewer-air to escape into the rooms. Or, the proper disposal of excreta, garbage, slops, and other refuse matter, may be neglected, thereby causing a nuisance upon the premises which is detrimental to the health of the occupants of the house. An insufficient supply of water may lead to general uncleanness and its evil consequences.

The interior finish and decoration of the house is a subject which should not be overlooked in its bearing upon health. The air of the rooms may be rendered unwholesome by the use of heavy-stuff hangings, tapestry,

and curtains, and cumbersome, ill-contrived furniture, which collect and conceal dust and dirt. The wall-paper may be made of fluffy material, which absorbs moisture and impurities, or it may contain poisonous substances. The floors may be so constructed as to leave innumerable crevices, in which dirt collects and is retained. The practice of covering the whole floor-space with carpets, carefully fitted to every recess and tightly nailed to the woodwork, is opposed to cleanliness. The labor and expense attending their removal for the necessary cleansing forbid the proper attention to this important particular; consequently, they are permitted to remain for months, and even for years, accumulating dust and dirt all the while, the only cleaning to which they are subjected being that done by the ordinary sweeping of the surface, which removes a certain amount of dust and fluff. Under the circumstances, it is easily seen how the floors become filthy and the carpets foul and unhealthy, and impart these qualities to the air of the apartments. In these and in many other ways, a neglect of the proper sanitary construction, arrangements, and fittings of a dwelling may lead to the discomfort and ill-health of its occupants.

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## CHAPTER I.

# SITE, CONSTRUCTION, AND INTERNAL DECORATION OF HOUSES.

The site for a dwelling is rarely selected from a consideration of the healthiness of the location, particularly in its relation to the conditions of the soil. Other considerations, often of an accidental character, more frequently determine the choice. And yet there is no more important subject to be taken into account in planning a house, none which demands a closer scrutiny, in view of its influence upon the health of the occupants, than the character of the soil in which its foundations are laid. It is not the good fortune of every one to select the spot upon which to build a house; but where such an option can be exercised, a knowledge of the essential features of a healthy site will be of the greatest service; and in those cases, by far the most numerous, in which a choice is denied, such information will be of the greatest advantage in detecting and remedying unfavorable conditions, and in improving the healthiness of a site.

### Conditions of the Soil Affecting Health.

It is only within recent years that public attention has been generally directed to the important relationship existing between certain physical characteristics of the soil and health. The ground-air, ground-water, and dampness, have all been studied in connection with their agency in the production of certain diseases of common occurrence, and important facts have been arrived at, which are of great advantage in instituting measures for the preservation of health. Paroxysmal fevers, typhoid fever, bilious remittent fever, dysentery, diphtheria, and cholera (during epidemics of that disease), have all been attributed to telluric effluvia. It is a well-known fact that dampness of the soil will cause catarrhal affections, rheumatism, and neuralgia. It has been clearly shown that dampness of the soil under houses is one of the chief factors in the production of consumption—that plague of our climate which destroys more lives than any other disease. Typhoid fever has also been supposed to be connected with changes in the water in the soil. A similar view is held with regard to dysentery, bilious remittent fevers, and cholera. It is thus seen how potent are the influences of certain conditions of the soil in undermining health, and in causing disease, and therefore how important it is to use every means for protecting ourselves against these enemies of health.

### The Air in the Soil.

All soils and most rock formations are more or less porous, and are capable of holding in their pores and spaces air or water, or both. When air as well as water is present, the soil is said to be moist. Only the hardest rocks are free from air. Gravel and loose sands are well known to be very porous, the latter containing often as much as half their bulk of air. The amount of air in some varieties of soft sandstones sometimes reaches 40 per cent. The composition of the air in the soil is variable, and differs widely from that of the free atmosphere. Carbonic acid in variable quantity is usually one of its constituents. The origin of this gas is supposed to be due to organic changes taking place in the soil itself. It cannot be derived from water precipitated from the atmosphere, as the amount of this gas in meteoric water is exceedingly small. Nor is it to be sought for in the ground-water as a source; but it is most likely derived from the soil, and is imparted to the ground-water and ground-air simultaneously, but more freely to the latter on account of its greater absorbent capacity.

### The Sources of Polluted Ground-Air.

The ground-air contains more or less moisture, and is liable to be contaminated by effluvia and organic matter arising from the constituents of the soil. A frequent source of ground-air pollution in inhabited places



is the impurities which soak into the soil from leaking cesspools and drains, from badly constructed sewers, from leaky gas-mains, and from deposits of filth upon the surface of the ground.

It is important to observe that the air in the soil is in continual movement. This movement is especially active in dry, porous soils. The motion of the air in the ground is caused by pressure of the atmosphere and wind against its surface; by changes in the temperature of the lower strata of the atmosphere and of the upper surface of the soil; by the rain-fall, and by changes in the level of the ground-water; and, to some extent, by the operation of the law of diffusion of gases. At every rain-fall, the pores of the superficial layers of the ground are closed by the inflowing water, so that the upward escape of the imprisoned air is hindered, while the rise in the ground-water exerts a pressure from the opposite direction; under the circumstances, the ground-air seeks an outlet at the point of least resistance, and, in many cases, escapes into dwellings—the more freely, the more extended and copious the rain-fall.

A current in the ground-air may be caused by local conditions; thus, a house artificially heated, being warmer inside than the external air, will cause a current of air to enter it from the ground on which it stands. Any impurities in the surrounding soil may find access to the house through this channel. Numerous instances have been recorded of the penetration of coal-gas into dwellings through the pores of the soil under the basement floors, the entrance of the gas being facilitated by the activity in the current of ground-air caused by the heated house. Ill-health, and even death, has been caused by gas escaping into houses in this manner. In the same way the air made noxious by the oozings from cesspools and broken drains, and by foul matters contained in the soil, may gain entrance through the foundation floors.

### Some of the Features of a Healthy Site.

The fact that the ground-air is in continual intercourse with our houses, and readily absorbs and bears along in its current impurities, or, it may be, the germs of disease, existing in the soil, should never be lost sight of in choosing the location of a dwelling, and in planning and constructing the ground floors and foundations. A clean, natural soil, such as is free as possible from those organic changes or processes which cause unhealthy emanations, should be the prime object of such a choice. No effort should be spared in improving the healthiness of a site. This may be accomplished by keeping the soil clean through efficient drainage, abolition of cesspools and other sources of filth-impregnation, and an abundant source of water for maintaining cleanliness in all parts of the house. And further, by making the ground floors and walls, as far as possible, impermeable to air.

"Made-ground" is to be looked upon with the greatest suspicion. Such a soil, generally composed of the refuse of a town, is necessarily very impure, and a house built upon it is liable to be unhealthy. A process of purification by oxidation and the influence of rain, naturally takes place in the course of time, but the certainty of the result should always be determined by an examination of the ground. It is, however, best to avoid such a location altogether.

Porous soils, such as those composed of gravel or rubble, are generally supposed to be healthy, but the assumption is not to be taken without qualification. The great facility which they afford for the circulation of air, and, through this medium, of conducting impurities for a long distance, aided by the suction power of the house, makes it essential that such soils, in order to be healthy, should be free from noxious effluvia and deposits of animal or vegetable matter. Dry, porous soils, otherwise unobjectionable, may be the source of malarial exhalations. The ground in inhabited places, and even about isolated dwellings, often becomes impregnated with filth from sewers, broken drains, cesspools, and refuse heaps, which undergoes decomposition and gives rise to noxious gases which are dangerous to health in proportion to the degree of concentration. Such a filth-sodden soil is, moreover, a convenient *nidus* for the production of those morbidic ferments which seem to be connected with certain palpable organisms, which are looked upon as very important agents in the production of some of the common diseases that afflict humanity.

#### Diseases Due to Emanations from the Soil.

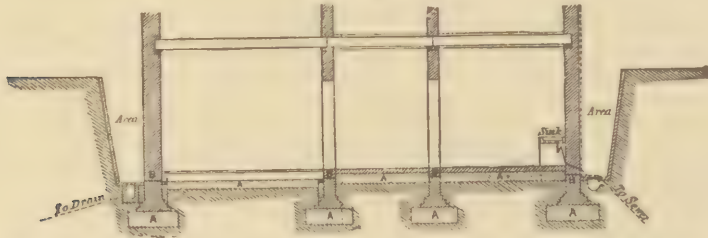
Among the diseases which have been attributed to emanations from the soil may be mentioned typhoid fever,—that scourge of the country as well as the city,—cholera, malarial fevers, dysentery, and diphtheria.

#### The Means of Preventing Exhalations from the Soil.

From what has already been said, it is evident that it is of the greatest importance to health that our houses should be protected from the access of ground-air. The selection of the site is of primary importance. If possible, all sources of pollution should be promptly removed. As it is impossible to prevent the circulation of the air in the ground, structural devices must be employed to keep the soil-exhalations from rising up into the house. This is best accomplished by covering the entire site of the house with a layer of cement, concrete, asphalt, or some other impervious material. A layer of concrete at least six inches deep, well rammed and well grouted with liquid cement, and made smooth upon the surface, makes a most satisfactory barrier to the ground-air and dampness (Fig. 66). A good layer of asphalt placed over the concreted basement floors,

or stone flagging laid in cement, affords an excellent finish, and yields an additional protection. Such a floor has the advantage of being free from cracks and holes, which harbor dirt and vermin.

FIG. 66.



FOUNDATIONS AND BASEMENT FLOOR. ARRANGEMENTS TO EXCLUDE GROUND-AIR AND DAMPNESS. A, CONCRETE BED; B, DAMP-PROOF COURSE.

Another means of defence is secured by ventilating the foundations and basement below the ground floor, which may be effected by raising the floor above the ground and using ventilating bricks (Fig. 67). The ventilating chamber thus formed beneath the cellar floor would be more satisfactory if connected with a chimney flue used solely for this purpose, so as to insure the dispersion of the ground-air. It may even be expedient to raise the house above the surface of the ground, so as to afford free circulation of air between the lower floor and the ground. This plan is frequently practiced at many of the resorts along the seashore, and has the advantages of free ventilation and protection against damp.

FIG. 67.



VENTILATING BRICKS.

### The Water in the Soil.

No one need be told that the earth absorbs water more or less freely, and retains or parts with it with greater or less facility. We see the rain fall upon the earth and disappear into the soil, where it collects and fills our wells, supplies our springs, and, oozing from the earth again, feeds our streams and rivers. But there are some important facts relating to the water in the soil, in connection with its salubriousness, which require explanation. A soil is said to be moist or damp when its pores contain both water and air. Soil-moisture must be distinguished from ground-water, a term borrowed from the German "*grund-wasser*," which is used to designate the continuous stratum or body of water formed by the saturation of the pores and spaces in the soil to a certain level found at variable depths below the surface of the ground. The surface of this body of



water is called the water-level, water-table, or line of saturation, and forms a boundary line between the completely saturated soil beneath and the ground above it, which is merely *damp*, that is, its pores and spaces are filled partly by air and partly by water.

The accompanying illustration (Fig. 68) represents the results of an examination of the soil at Munich, with respect to the relative positions

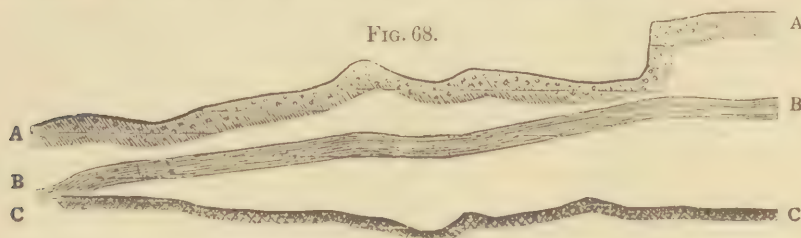


FIG. 68.  
PROFILE OF THE SOIL AT MUNICH, SHOWING THE SURFACE OF THE GROUND (AA), THE GROUND-WATER LEVEL (BB), AND THE UNDERLYING IMPERVIOUS STRATUM (CC).

of the surface of the ground, the surface of the ground-water, and of the impermeable stratum or water-basin. The soil between A and B is simply moist, but between B and C it is completely saturated with the ground-water.

The level of the ground-water is constantly subject to fluctuations, that is, it rises and falls in response to various influences. These variations

are brought about by the amount of rain-fall and evaporation, by changes in the outlets of the water from the earth, and in the amount of resistance encountered at the places of escape. The tides exert a marked influence on the ground-water level. The amount of rain-fall cannot always be taken as a reliable index of the state of the ground-water. A ready way of gaining this information is by taking the measurement of the water-level of a number of wells in different parts of the same district at the same time. For ordinary purposes a weighted rope may be used. When very accurate results are required, the method adopted by Professor Pettenkofer, as illustrated by Fig. 69, may be employed. It consists in the use of a rod, with a number of shallow cups fixed on it, which is lowered into the well by a cord and drawn up again. The length of the cord and of the rod to the uppermost cup which

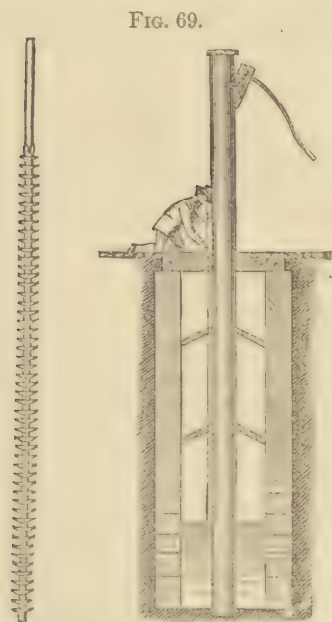


FIG. 69.  
MEASUREMENT OF THE GROUND-WATER.

contains water marks the height of the water in the well. To insure reliable results, no water should be drawn from the well for some hours

before the measurement is taken. In some places the variation in the surface of the soil-water is but slight, while in others the changes are very marked. This is particularly the case in countries where the rain-fall is limited to particular seasons of the year, and is very heavy, as in some parts of India, where the difference between the extreme measurements has reached from sixteen to seventeen feet. The level of the water may be very near the surface, as in marsh lands, or it may be found at very great depths. This depends on the arrangement and character of the soil and of the underlying strata, and also upon the character of the outflow. The surface of this subterranean water-shed is not necessarily horizontal, as is shown in Fig. 68. The ground-water is in constant movement, and its course is generally towards the sea or nearest stream. The rate of flow is never great; indeed, it may be hardly perceptible.

There is a great difference in soils with respect to their power of absorbing and retaining moisture. Loose sands, gravel, and sandstones absorb water freely, and also part with it freely. Some vegetable soils, such as *humus*, absorb it freely and retain it very tenaciously. *Humus* may take up as much as sixty per cent. of its volume. The denser soils, and even granite, slate, and hard marbles, may sometimes contain water. But for sanitary purposes soils may be divided into the permeable and impermeable. The former (gravel, sand, soft limestone, sandstones, and so forth) allow water to flow freely through them; the latter, such as dense clays, hard limestones, slate, trap, metamorphic rocks, granite, and so forth, do not allow the free passage of water through them, and are, for practical purposes, said to be impervious. Water admitted to a porous soil, flows freely through it until it comes to an impervious layer, such as clay, where it collects and over which it flows until it finds an outlet. Should the formation of this impermeable stratum be like a basin and hold the water, the ground becomes permanently saturated, and is said to be "water-logged."

The amount of moisture in the ground depends on the character of the soil and the supply of water from the rain-fall and ground-water. Rain is the principal source of soil moisture. The ground-water, by its constant rise and fall, tends to keep the soil above it in a moist condition. A damp state of the soil is, moreover, favored by constant evaporation from the surface of the underground-bed of water and by capillary attraction. All these influences combined, serve to keep the subsoil, in most places, more or less moist.

### Dampness of Soil Injurious to Health.

Dampness of the soil is generally regarded as inimical to health. This condition of the ground is known to predispose to catarrhal affections, rheumatism, and neuralgia. Marshy and water-logged lands have much to do with the development of the morbid agent which is the cause of

paroxysmal fevers. It has been determined, upon the best of evidence, that dampness of the soil under houses, is one of the prominent factors in the production of consumption. There can be no doubt that many diseases arising from other causes are intensified, and recovery therefrom retarded, by this unfavorable condition of the site.

It may be well to mention that the theory has been advanced by competent observers, especially in Germany, that typhoid fever, cholera, and dysentery are often connected, in some way, with a moist state of the soil, due to variations in the level of the ground-water. A soil which has become contaminated by organic impurities and rendered moist by the rise of the ground-water, and then exposed to the action of air and heat during the subsidence of the ground-water, is supposed to furnish conditions exceedingly favorable for the propagation of these diseases, provided, however, the specific germs have gained entrance into the ground.

From what has been said, it is evident that the health of the occupants of a house is influenced to a greater or less extent by the conditions of the soil upon which the house stands. Bacon has said that, "He who builds a fair house upon an ill seat, committeth himself to prison." He might just as truthfully have added, "and to the tomb," for death is very frequently the termination of sickness produced by living in an unhealthy house. In selecting a site then, see to it that the soil is free from contamination by organic impurities; that it is free from dampness and sudden and violent fluctuations of the ground-water, that is, at one time dry or barely moist, and, at another time, soaked with water.

A dry, porous soil, in which the facilities for natural drainage are good, and the level of the ground-water persistently low, will, in most cases, be found to be salubrious. Elevation of site is generally an indication of the presence of this condition. On the other hand, a level surface is not to be avoided, since the essential features of a healthy site may likewise there exist.

In the country there is more freedom of choice than in the town or city, but it is not always wisely exercised. Other considerations than those of health far more frequently determine the site of the house. A damp condition of the soil may be kept up by the injudicious planting of trees and shrubs in too close proximity to the dwelling, or by neglect in diverting the drainage to some distant outlet, and thereby preventing it from soaking into the foundations. By improper location and arrangement of the barn-yard and cesspool, the ground-water under the dwelling may be constantly exposed to the danger of becoming impregnated with filth from these sources. A house located too close to the banks of a river, unless highly elevated, may be rendered unhealthy by the saturation of the soil from occasional freshets or unusual rise in the river, or by the influences of the tide.



**Aspect, Light, Prevailing Winds, Etc.**

Some other important points which influence more or less the healthfulness of a habitation are aspect, external ventilation, prevailing winds, and salubrity of locality. A preference should always be given to an aspect which gives light and cheerfulness; an exposure which ensures a free circulation of air without being subjected to violent gusts of weather, and defended, as far as possible, from the the north and east winds; a location free from mists and fogs, sudden vicissitudes of temperature, and from malarial and other injurious influences of climate. Dr. James Clark, in summing up the conditions necessary to insure a healthy habitation, remarks: "It may be stated as a general rule that houses in confined, shaded situations, with damp courts or gardens, or standing water close to them, are unhealthy in every climate and season, but especially in a country subject to intermittent fevers, and during summer and autumn. In our own country, nothing is more common than to see houses built in very unhealthy situations, a few hundred yards distant only from a good one. Again, houses in places otherwise unexceptionable, are often so closely overhung with trees as to be rendered far less healthy residences than they otherwise would be. Thick and lofty trees close to a house tend to maintain the air in a state of humidity, by preventing its free circulation and by obstructing free admission of the sun's rays. Trees growing against the walls of houses, and shrubs in confined places near dwellings, are injurious also, as favoring humidity; at a proper distance, on the other hand, trees are favorable to health. On this principle it may be understood how the inhabitants of one house suffer from rheumatism, headache, dyspepsia, nervous affections, and other consequences of living in a confined, humid atmosphere, while their nearest neighbors, whose houses are more openly situated, enjoy good health; and even how one side of a large building, freely exposed to the sun and to a free circulation of air, may be healthy, while the other side, overlooking damp, shaded courts or gardens, is unhealthy. The exemption of the central parts of a large town from these fevers, is partly explained by the dryness of the atmosphere which prevails there, and the comparative equality of temperature. Humid, confined situations, subject to great alternation of temperature between day and night, are the most dangerous. Of all the physical qualities of the air, humidity is the most injurious to human life, and, therefore, in selecting situations for building, particular regard should be had to the circumstances which are calculated to obviate humidity, either in the soil or atmosphere, in every climate. Dryness, with a free circulation of air, and a full exposure to the sun, are the material things to be attended to in choosing a residence."

It is not within the power of every one to select a location possessing every natural advantage; hence, the necessity of resorting to art to

improve the conditions as they exist. Fortunately, the means of doing this are well known, and can be applied with satisfactory results. It is obvious that whatever may be the character of the soil, all sources of contamination should be removed before the house is commenced.

### How to Remove Excessive Dampness from the Soil.

The soil can be rendered drier, and healthiness of the site improved, by drainage and by opening the outflow. Drainage not only removes the dampness, but, by opening the pores of the soil, permits the free circulation of air which is essential for the process of oxidation. The soil possesses the power of self-purification, provided the air is not excluded by the soil-water filling up its pores and spaces. For a building to be hygienic, the subsoil-water ought not to be allowed to rise higher than (say) five feet below the foundations. To secure this object, several lines of drain-pipes laid at this level, and discharging into a sewer or some other outlet, are necessary. It is understood that these pipes should be pervious to water, so that when it rises to their level it will find its way into them, and be carried off to some convenient outfall. Ordinary agri-



cultural tiles or land drainage-pipes will be found very convenient for this purpose (Fig. 70). If laid beneath stones or pebbles, their efficiency will be promoted. Sometimes these drains are connected with the pipes for

carrying off sewage, in which case a ventilated trap should be set at the lowest point of connection to prevent the ingress of foul air.

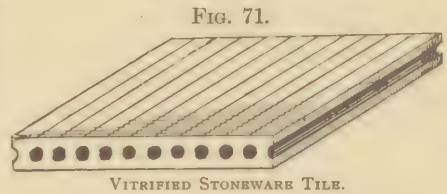
If the soil is composed of clay, or is low and sandy and always wet beneath the surface, as in places bordering on water, very little advantage can be secured from drainage. It would be best to avoid such places altogether; but if this cannot be done, it is advisable to elevate the house above the ground, so as to allow the free circulation of air beneath the lowest floors.

An additional protection against dampness is obtained by covering the entire basement floors with a good layer of concrete overlaid with asphalt, as already advised when speaking of protection against impure ground-air, and as is illustrated in Fig. 66.

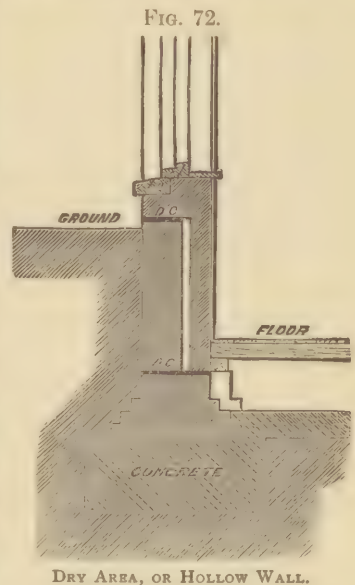
### How to Construct Foundation-walls to Keep Out Dampness.

The foundation-walls should be composed of the best materials, set in cement, and underlaid with a continuous bed of solid concrete. To prevent moisture from being absorbed by the materials and striking upward by capillary attraction, thereby injuring the walls and timbers and rendering

the atmosphere within the house unwholesome, it is essential that a damp-proof course of some impervious substance should be constructed in the walls just above the surface of the ground. Moisture will rise from the base of a wall, but is more liable to be absorbed from the earth against the sides of the foundation. Whatever may be the source of the moisture, a course of some impervious material inserted in the walls all around the house, above the level of the ground adjoining, will prevent it from rising above this point. Various kinds of materials have been used for damp-proof courses, such as slate embedded in cement, layers of sheet lead, or layers of asphalt. Enamelled bricks are sometimes used. Tiles or slabs of glazed stoneware are the best material thus far devised, and should be more frequently adopted. They are made of various patterns and thicknesses, and are generally perforated so as to admit air to the space under the flooring. One of these designs is shown in Fig. 71.



Dampness will strike through the walls below the damp-course, unless some additional precaution be adopted. This is afforded, to some extent, by lining the inner side of the walls of the basement with glazed or enamelled bricks, or with the best hard bricks. The most efficient method is to separate the walls from the ground by a well-drained area, as represented in Fig. 66. Care must be taken to have the bottom of the area below the basement floor, so that the damp-proof course, inserted below the level of the latter, shall protect it from the injurious effect of damp. If an open area cannot be constructed, a "dry area" may be provided in its place. This is formed by leaving an air-space between the basement wall and the second or area wall, which shall join the main wall just above the level of the ground. In this case it will be necessary to use two damp-proof courses; one located in the wall below the basement floor, and the other at the point where the two walls join each other, a few inches above the level of the ground. Fig. 72 furnishes an illustration of this plan.



Still another plan is that recommended by Eassie, which consists in the use of glazed stoneware tiles (such as those used for damp-courses) placed perpendicularly so as to form a casing on the outside of the wall, and

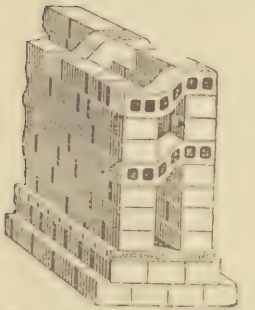
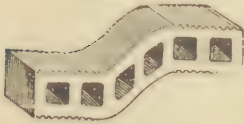


joined to it by the same kind of material. Support is given to the outside wall by using bonding-bricks, or wall-ties made of some impermeable material. The space in the wall should be ventilated and drained.

### Prevention of Dampness in External Walls.

The walls of a house are sometimes rendered damp by exposure to continued wet weather. Various means have been employed for protecting

FIG. 73.



HOLLOW WALLS AND STONE-WARE BONDING-BRICKS

the outside walls in exposed positions. Smooth, hard bricks, glazed bricks, slate, cement, weather-boards, and tin, have all been satisfactorily used for this purpose and under a variety of circumstances. Some walls are improved by a coating of good paint, but its frequent renewal makes it expensive. Hollow walls are not infrequently constructed as a protection against dampness. Two parallel walls are constructed with a space between them three or four inches wide, and joined together with bonding-ties of iron or stoneware. By this plan not only is dampness excluded, but a more equable temperature is maintained in the house. The bonding-bricks or ties are sloped and so arranged as to cast any moisture that may find access to the cavity toward the outer wall. If iron is used it should be galvanized and coated with tar and sand; the latter precaution being adopted to secure a

better union with the mortar. Fig. 73 represents hollow walls joined together by patent stoneware bonding-bricks, such as are much used in England.

In some cases, the cavity in the wall is made narrow and filled with asphalt, which forms an excellent protection against dampness.

### The Construction of Walls, Materials, Etc.

The walls of a house are generally constructed of bricks, stone, or a combination of these materials. Sometimes they are made of concrete, in imitation of a very ancient plan. A combination of brickwork and timber, known as "half-timber work," after an old English style, is being revived to some extent. Bricks have the advantage of standing fire better than any other material, as was clearly demonstrated by the great Chicago fire. Whatever may be the choice of materials, it is important that the quality be good, that the walls be well constructed in mortar or cement, and of adequate thickness not only to insure stability, but to keep out the weather and protect the air of the house from the influences of sudden changes of temperature of the external atmosphere.

Party-walls, which separate adjoining buildings, should be well and substantially built, so that in case of fire its spread from one house to another may be prevented. It is also important that such walls should be carried up through and above the roof, so as to form a parapet at least twelve or eighteen inches in height. To prevent dampness from passing down such a wall, its top should be covered with tiles, or properly sloped slabs of stone, or bricks on edge laid in cement. A damp-proof course is sometimes inserted in the wall where it joins the roof. A capping of tin is preferable to all these devices. In finishing the roof against the parapet, a proper flashing should be used to prevent dampness from finding its way into the house. A cement flashing is sometimes employed, but a flashing of tin or lead, let into the joints of the brickwork and sloped toward the roof, will be found to be more efficient.

#### The Proper Construction of Chimney-flues and Fire-places.

Chimney-flues and fire-places should claim attention. Too often their defective construction, and carelessness in the arrangement of the adjoining woodwork, are the cause of serious damage to buildings by fire. To insure safety, the brickwork of a chimney should be at least nine inches thick, and no wooden plugs or bricks should ever be inserted in it, lest they become charred and ignite and set fire to the house. In order to facilitate draught, the flues should be as straight as possible, and should have a smooth interior surface. A lining of terracotta or stoneware pipes is to be recommended for improving the draught and guarding against fire. These flues can be obtained of different sizes and in a variety of shapes, some of which are represented in Figs. 74 and 75.

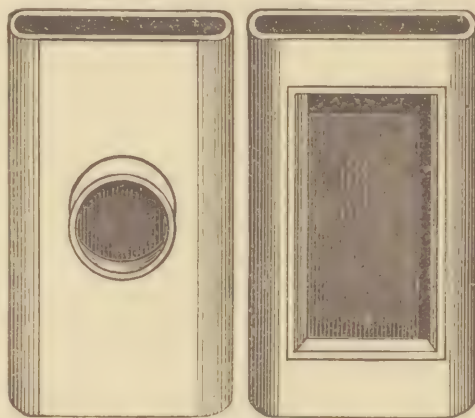
No combustible materials should be allowed in close proximity to fire-places. Very often fire-places are constructed in chimneys not originally designed for this mode of heating. To avoid expense, the joist and trimmers are allowed to remain under the hearth in close proximity to the original brickwork, and owing to this neglect or want of foresight, fires are of frequent occurrence.

#### A Good Roof an Important Feature of a House.

A thoroughly good roof is an important feature in the sanitary construction of a dwelling. A roof may be so constructed as not to keep out

FIG. 74.

FIG. 75.



STONEWARE VENTILATING AND CHIMNEY-FLUES.

the weather, or it may allow snow to accumulate in large quantities, so that when a sudden thaw takes place, the water overflows the gutters, saturates the walls, and causes dampness within the dwelling. It may also fail to protect the house from the influences of the external temperature. If not properly constructed, it is a constant source of annoyance. Roofs are usually constructed of timber, and covered with various kinds of materials as a protection. Slate, tiles, zinc, copper, lead, and tin, are all used for this purpose. Tarred felt and gravel composition are sometimes applied to temporary structures. The shingle roof is not so much used as formerly.

The slope of a roof depends on the kind of material used for its covering. A well-jointed metallic roof requires but a slight inclination. With slates, shingles, or tiles, it is otherwise. A slate roof, to be serviceable, should have the slates lap at least three inches to keep out rain and snow. The slates should be laid upon a substantial boarding, and should have a layer of felt interposed between them and such boarding. The ridges and hips should be protected with lead, or tin, or with tiles constructed for this special purpose. The gutters and flashings may be made of tin. Tin is now most commonly used for a roof-covering, and it is the most desirable material, on account of cheapness, durability, and facility of adaptation. A coating of good paint is required to protect it from rust.

The eaves and cornices and projections of a house should be so constructed as to throw the water off from the walls, otherwise the walls may be continually damp. Gutters for conducting the water into some safe outlet, should be provided whenever required. Great care should be taken in the arrangement of the spouts, or rain-water pipes. They should never be carried within the house, unless special precautions are used to prevent the bad effects of an obstruction or a leak. It is a good practice to fix the spouts an inch or more from the wall, so that in the event of a stoppage, a leak, or an overflow, the water may not run down and soak into the walls. Rain-water conductors are frequently connected with drains or sewers, and are sometimes used for ventilating drains. This practice is not a safe one, as the conductors are neither constructed nor arranged for this special purpose, and even when provided with traps, are very liable to act as channels for conveying sewer-air into the house.

### **Floors and Floor-coverings.**

Only dry and well-seasoned timber should be used for the flooring of a house. The boards should be closely joined, so as to present a smooth, even surface that is free from cracks, which collect dirt, and also to prevent water from leaking through to the ceiling beneath, or air from passing upward from the room below. The ploughed and tongued floor and the dowed floor have great advantages, and are generally used

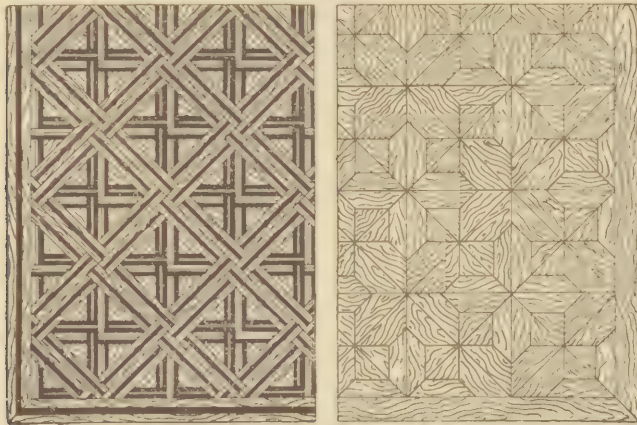


for superior work. They are very compact and substantial, and, being free from crevices, do not gather dust and impurities.

Parquetry is a superior kind of inlaid flooring, composed of different varieties of hard wood, arranged in various designs, and intended to cover a floor for its decorative effect. "Wood-carpet" is a species of parquetry much used for covering floors where ordinary carpets are dispensed with. It is capable of all kinds of designs, is laid with facility, and forms a compact, neat, and beautiful finish (Fig. 76).

Double floors, composed of two sets of joists (the lower set to support the ceiling), are used with the advantage of protecting the ceiling from jarring overhead, and of deadening sound. Fire-proof floors made of concrete, or of brick arches supported on iron girders, are very desirable, though not adapted to all kinds of buildings.

FIG. 76.



CARPET PARQUET.

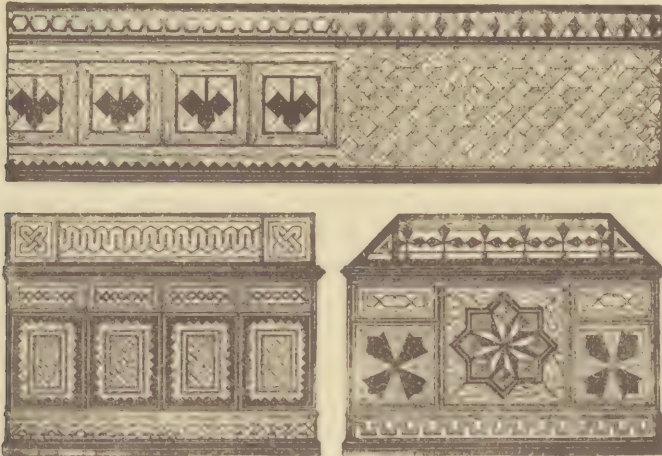
Basement floors laid upon concrete, or other kinds of foundation, and all other floors having a space between them and the ceiling below, should always be ventilated. This may be accomplished by inserting perforated bricks or iron gratings in the outer walls.

Until within a few years it has been the custom to cover the entire floors of a dwelling with carpets made to fit into all the angles and recesses, and tightly nailed to the woodwork. When carpets are adjusted in this manner, it is troublesome and expensive to remove them as often as is required for the necessary cleaning; consequently, they are suffered to remain for an undue length of time, seldom being taken up more than once a year, or oftener than required for the usual spring and fall house-cleaning. Dust and dirt accumulate in and under the carpets and around the borders, and is only partially removed by the ordinary sweeping of the surface, most of the dust and fluff raised by the act of sweeping, settling down again on the carpet and upon every article of furniture or ornament

in the room, and requiring constant labor to remove it. A room thus closely fitted with carpet, which is a mere dust container, cannot be otherwise than unhealthy. The present fashion of abandoning the closely fitting carpet and substituting in its place parquetry, or rugs and square carpets on stained and varnished floors, is an important step toward effecting an improvement in the sanitary condition of the dwelling.

The floor-covering, if any be used, should never be laid over the entire surface. Rugs, square carpets, and matting answer the purposes of comfort and decoration, and possess the advantage of being removed\* without labor and of allowing the floor to be frequently cleansed. It is therefore important that the floors of a house should be laid in a very careful manner. The surface should be smooth, and no gaping spaces should be left between the boards or around the surbase to collect particles

FIG. 77.



WAINSCOTING WITH WOOD CARPET.

of filth. In old floors, the spaces should be cleaned out and filled in with good oil-putty, and the whole surface painted in several coats of good paint, or stained and then treated with "hard-oil."

Hard-wood parquetry makes an impervious, durable, and beautiful flooring. The "carpet" parquet, which is a veneer of wood, is an excellent substitute. Glued or tacked to an ordinary floor, it forms an admirable surface, which may be easily kept clean, and is pleasing in its effect. It is durable, cheap, and washable. There is a great variety of patterns to select from in this convenient form of floor-covering, some of which are represented by Fig. 76.

"Wood-carpet" is also designed for wainscoting. It makes a neat, cleanly, and elegant covering for the lower surface of the wall. Several ornamental designs, furnished by Mr. Boughton, are shown in Fig. 77.

### Walls and Wall-coverings.

Walls are usually coated with plaster composed principally of lime or cement. Such a covering should possess the qualities of hardness and density, otherwise it is liable to absorb moisture and organic or other impurities. For small cottages and the cheaper class of dwellings, lime-wash forms an inexpensive and cleanly finish. It admits of decoration by the addition of color, can be renewed without much expense, and has the further advantage of a purifying effect.

An excellent result is obtained by covering walls with good paint. A smooth, hard, non-absorbent surface is thus procured, which can be washed as often as necessary, without detriment. The so-called "indestructible" paints and zinc-white are preferable to white-lead. The practice of covering the walls of a room with paper printed in colors cannot be recommended on sanitary grounds. The paper itself is composed of organic matter, the paste used may become mouldy, and there is also the risk of selecting such material as contains poisonous coloring matter. Unless varnished, wall-paper cannot be washed. Impurities absorbed by it and collecting on it cannot be removed without removing the paper itself. Hence, it becomes necessary, after the presence of infectious or contagious diseases, to remove all such covering, and to scrape and clean the walls. As wall-papers will continue to be used, it is necessary to observe caution in selecting the colors. The brilliant colors often depend on the presence of arsenic, lead, copper, and antimony salts. The neutral tints are preferable, as they are less likely to contain poisonous matter. Felt, velvet, and all fluffy papers should be avoided, as they are very liable to absorb and retain impurities.

In re-papering old walls, every particle of old paper should be removed—a practice not always observed on the score of economy. The paste of old papering is apt to decompose and become putrid, and each additional layer adds to the evil by increasing the thickness and absorbent powers of the covering. The paste used in paper-hanging should be composed of good wheat flour and *clean* water, and should be applied while fresh.

Ceilings are most generally plastered. The same care is required in their construction as has been advised in the case of plastered walls. Several coats of good paint will furnish a smooth, hard surface, which can be easily cleaned without injury, and will also afford the best foundation for whitening or distempering. The latter process makes a neat finish, and may be renewed as often as need be, without much expense, after first wiping off the previous coat with sponge and water. For ordinary houses, nothing is better than lime-wash, which is a cheap application, and is desirable on account of its purifying effect. Ceilings thus treated should be occasionally scraped, otherwise cracks and crevices will form, in which dust will collect, and a further annoyance may be created by the lime peeling off and soiling the floors. Paper is a good deal used at



the present time for covering ceilings. The practice is not commendable, as this material is absorbent and very apt to become saturated with impurities carried upward by the heated air of the room. If wood is used for ceilings, no joints should be left to collect dust. Panelled wood is the best description for this kind of finish.

The woodwork about the house may be stained and varnished, or oiled and polished, or painted. Natural wood, oiled and polished, or varnished, the pores first having been "filled," makes a most desirable finish, and is rapidly coming into general use. Whatever may be the choice in this respect, it is important that the materials used shall, as far as possible, be impervious, and so applied as to present a smooth, even surface that will repel dust and dirt and admit of being easily cleaned. This recommendation applies with equal force to all the interior finishing of the house.

### **Internal Decoration and Furnishing.**

The internal decoration and fittings or furnishing of the house may exert no inconsiderable influence on health, and it is therefore important that they conform, as far as possible, to the principles of sanitation, so as to conduce to the health as well as the comfort of the occupants. Although the people have shown, of late, an increasing interest in the application of sanitary science to the improvement of the dwelling, and have evinced a desire to set their houses in order, there is still a lack of appreciation, on their part, of the important relation of the interior arrangements of the dwelling to health. "In all matters of mere decorative treatment of our rooms, there has been evinced an almost equal amount of carelessness as of ignorance, and until quite recently we have been content to paper, paint, and whitewash our buildings without any regard to their healthy and proper decorative treatment. The sanitation of the house has been thought to consist merely in the proper arrangement and ventilation of the drains, and the ventilation of the rooms in some form or other; but the first elements of fitness and simplicity of treatment, harmony of coloring, and suitability and common sense in the covering of our floors, the decoration of our walls, and the furnishing of our rooms, would seem to have been utterly neglected; so that it would, a few years back, have been deemed absurd to discuss any question of wall painting or papering, or any arrangement of floor-covering, or general treatment of the furniture and fittings of a house, from any mere sanitary point of view."

Allusion has already been made to the unhealthy practice of covering the whole floor-surface with carpets, of papering walls with materials absolutely pernicious to health, of leaving cracks and crevices in floors, walls, and ceilings to serve as resting places for dirt. It is also clearly evident that all furniture, which, by its excessive decoration or peculiar construction, collects and conceals dust and dirt that cannot be easily detected and removed; all heavy drapery, so commonly hung in

profusion about living and sleeping apartments, which cannot be cleaned with facility, and which excludes light and air—such, for example, as window valences, fringed lambrequins for the mantle-piece, heavy-stuff curtains, Turkoman portieres festooned about doorways, and drapery enclosing the couch; all over-ornamentation of ceilings and cornices by elaborate mouldings which defy all attempts at cleansing; the so-called artistic furniture loaded down with ornaments of china and glass, and “what-not,” which furnish so many hiding places for the ever-present dust; all these are, to a great extent, objectionable and unhealthy.

Simplicity in design, beauty and grace in shape, and fitness for the purposes intended, are essential features in objects of daily use, as opposed to unnecessary and unmeaning ornamentation which is inartistic and ugly, more costly and more difficult to keep clean, and utterly at variance with the object of practical service. Bulky pieces of furniture are too heavy to be easily moved to permit of the necessary cleansing of the floor-space, and of the walls behind them; consequently, these articles are often allowed to remain in position for years, while concealing the accumulations of dust, which have the effect of rendering the air of the room impure and more or less unhealthy.

It is advisable that “the bed-rooms of a house should be kept as free as possible from all useless hangings which impede air circulation; the furniture simple and useful, well made and dust-tight; the floor-surface left free all around the walls and under the bed and wall furniture, and carpeted only so far as is necessary for comfort; all ledges and resting-places for dirt should be carefully avoided, such as Venetian blinds, valences to beds and windows, and inaccessible shelves; the fire-places left open—not closed up as is often done in summer time with curtains and useless hangings; the woodwork polished or varnished, so as to be easily cleaned; and the walls covered with simple pattern papers or distemper, so as to present no spotty surfaces for the eye to rest upon.”

There can be no question about the fact that the internal arrangements and management of the house have a very marked influence upon the health of the occupants. Impure air debilitates the system, and, under certain circumstances, acts directly as the cause of disease. Whatever impedes the free circulation of air, obstructs light, hinders ventilation, absorbs and holds impurities, collects and conceals dust and dirt, acts as an enemy to health. Tapestry and stuff-hangings are quite unnecessary; the carpeting of every angle and recess of a house is a positive nuisance; poisonous wall-paper and papers of a fluffy, absorbent nature are certainly pernicious to health. These and other faults connected with the modern style of furnishing houses, which do harm by rendering “the accumulations of filth not only likely, but positively inevitable,” are to be avoided as being inconsistent with the laws of health. Thorough cleanliness of the dwelling, and of all that it contains, is the important object to be kept steadily in view, and should never be sacrificed to the love of fashion and excessive decoration.

## CHAPTER II.

# VENTILATION AND HEATING.

As these subjects are more or less intimately related to one another, it will be most advantageous to consider them in close connection. A correct understanding of the principles involved in their study is highly important, as our comfort and well-being depend, to a great extent, on the proper regulation of these necessary details of the dwelling. It is surprising that the progress made in ventilation has been so slow, while architecture and the various details of house construction have advanced with such rapid strides. Indeed, it has only been within the present century, and particularly the latter part, that the importance of the subject has been brought prominently before the public attention. Our knowledge is still measurably deficient, and, to a greater extent, there is a want of appreciation and of practical application of the information already in our possession. To corroborate this statement it is only necessary to refer to the myriads of dwellings, and other structures in which people congregate,—the costly and luxuriously-appointed residences of the rich, as well as the humble cottages of the poor,—which are so scantily supplied with air of proper quality and quantity as to become the breeding places of disease.

### Pure Air Essential to Health.

Pure air is essential to our well-being. In fact, perfect health is impossible without a proper supply of pure air, the other conditions, of course, being present. We spend a large portion of our lives within doors, frequently under circumstances that prevent the proper supply of pure air, the consequences of which are seen in the general impairment of health, in the aggravation of disease, and in slow recovery from sickness. The more nearly the air of our rooms approximates the conditions of the external atmosphere, the more capable is it of sustaining the vital forces of the body.

### The Composition of Normal Air.

In order to clearly comprehend our subject, it is necessary to inquire into the composition of normal air. The air is composed of oxygen and nitrogen, which are the essential elements, and of carbonic acid, watery vapor, traces of organic matter, and of ozone, which is a changed condition of oxygen.



Oxygen is the active principle of the air—the element which is essential for the support of animal life. The nitrogen seems to act as a mere diluent, “to prevent the oxygen from burning or destroying everything with fire and rust.” Carbonic acid is present in small amount, which is variable within narrow limits. It has no part in sustaining animal life, but is harmless when in moderate quantity; it is, however, essential for the support of the life of the plant. The amount of watery vapor contained in the air is subject to constant fluctuations, and is influenced chiefly by the temperature. When, at a given temperature, the air has taken up a certain amount of moisture and can contain no more, it is said to be saturated. The point of complete saturation is designated as 100. The amount of aqueous vapor best adapted for health is supposed to be from 50 to 75 per cent. of saturation. When beyond these limits, the air is noticeably dry or moist. Traces of organic matter and ammonia, and variable quantities of suspended matter, are also to be found in the air.

According to Dr. Angus Smith, air taken under the most favorable circumstances, in free open spaces or on elevated ground, consists of the following constituents (in 100 parts by measure):

|                             |                           |
|-----------------------------|---------------------------|
| Oxygen, . . . . .           | 20.96.                    |
| Nitrogen, . . . . .         | 79.00.                    |
| Carbonic acid, . . . . .    | 00.04.                    |
| Ozone, . . . . .            | Variable.                 |
| Vapor, . . . . .            | Varying with temperature. |
| Organic matter, } . . . . . | Very minute traces.       |
| Ammonia, } . . . . .        |                           |
| Suspended matter, . . . . . | Variable.                 |

It is interesting to observe that the composition of the atmosphere in various parts of the globe is remarkably uniform. It might be supposed that the air of inhabited places and in the streets of densely populated cities would vary greatly from the normal standard, considering how numerous and constant are the sources of defilement which are there to be found; but such is not the case. By the law of diffusion and by the effects of the wind, nature is unceasingly dispersing the impurities which man, unavoidably, or through ignorance, is constantly discharging into the atmosphere.

#### Causes of Deterioration of Air in Enclosed Spaces.

The air may be rendered impure by a variety of causes. Among these may be mentioned noxious gases and irritating substances given off by certain trades and manufactures, effluvia from sewage and other refuse matter, deficiency of cleanliness, respiration, cutaneous exhalations, and the products of combustion. The consideration of the gases and suspended matter given off by trades may be omitted, since it belongs more properly to the domain of public hygiene. Sewage emanations, and impurities due to want of cleanliness and careless treatment of refuse matter, are

avoidable causes of air-pollution, and their effects ought to be counteracted by removal of the cause and not by trusting to the agency of ventilation. "It is an inexcusable waste of ventilation, if it is directed against avoidable pollutions of the air, besides its being generally of not much use for the purpose. The rational way is to do away with the pollutions, not to keep them and to fight them by ventilation." The air of dwellings is rendered impure by the products of combustion. These are principally carbonic acid, carbonic oxide, water, and smoke. The products of fires pass out into the atmosphere by special outlets; those generated by lights are for the most part allowed to diffuse in the room.

Mention has already been made of special conditions connected with the site of a building by which impure ground-air is allowed to flow into the house, and the means of its prevention pointed out.

#### **Air Vitiated by Respiration.**

The most common causes of deterioration of the air are respiration and cutaneous transpiration of men. We constantly change and pollute the air in our houses by depriving it of a portion of its oxygen in its passage through the lungs, and by adding to it an increased amount of carbonic acid derived both from the lungs and from the skin. Foul organic matter and moisture are also exhaled from the lungs and from the surface of the body. Carbonic acid is injurious when present in excess; but it is the organic matter in inhabited rooms that is most hurtful, and which renders the air close and offensive. These alterations and pollutions are the inevitable results of the constant and unalterable processes of life, and therefore cannot be avoided.

#### **The Prime Object of Ventilation.**

As already observed, the composition of the outer air is remarkably constant, notwithstanding the never-ceasing impurities discharged into it by the devices of man, and from the waste processes of life. Nature, by her bountiful laws, has made provision for neutralizing and dispersing the injurious substances thus imparted to the atmosphere, and for maintaining a degree of purity essential for the normal processes of life. By shutting out the pure air of heaven, and by polluting the limited supply within our dwellings, we attempt to thwart the design of nature and deny ourselves the blessings of health. It is evident the nearer the air in our dwellings approaches, in composition, the outer air, the more it conforms to the natural standard of purity, and, therefore, the better adapted to the needs of the economy. This is the object intended to be accomplished by ventilation. Of course, it is not possible to attain to this standard absolutely, without dangerous exposure to currents of air, or draughts. Nevertheless, by the use of well-known devices, the air of our dwellings may be rendered fresh and wholesome, and not perceptibly different from

the outer air. The sense of smell carefully employed has been proposed as a practical test of sufficient ventilation, the precaution being observed of entering the room as directly as possible from the open air, since the sense of smell becomes quickly obtunded—a fact which every one must have observed after entering a room that, at first, was offensive.

It is necessary for our comfort and health, that the air shall be constantly flowing about us, supplying us with its vivifying principles, and dispersing whatever is noxious and hurtful. It is therefore essential that the air of our houses shall be in constant intercourse with the outer air. This intercourse always takes place to a greater or less extent in spite of our acts. We may shut ourselves up in our houses and try to exclude the outer air, but it still gains access through the chinks and cracks in windows and doors, and, to some extent, through the pores of the walls and foundations, and is in continual movement about us. If it were otherwise, we should in all likelihood have ceased to exist.

The change and volume of air thus admitted may be insufficient for our needs, since we are constantly altering and polluting it by burning fires and lights, by the exhalations from the lungs and skin, and by the necessary procedures of the household. In order to maintain the proper standard of purity, it will not do to trust to the slow process of diffusion, and therefore it becomes necessary to resort to ventilation, which consists in the displacement or removal of the air containing these impurities by a constant stream of pure air from outside.

### The Restricted Application of the Term Ventilation.

Some writers use the term ventilation to designate the removal of all impurities that may be found in inhabited rooms. Others restrict its application to such impurities as are given off from the lungs and skin, and by the ordinary products of combustion. All other sources of impure air they consider as avoidable and capable of removal by attention to cleanliness. Says Dr. Pettenkofer: "Without strict cleanliness in a house or public institution, all contrivances for ventilation will not do much good; the proper domain of ventilation begins where cleanliness, by rapid removal or careful shutting up of air-polluting substances, has done its best. It is only against the deterioration of the air by respiration and perspiration, which are beyond the control of cleanliness, that ventilation can direct its power, and against this deterioration this power must be chiefly directed." This view is strictly correct, and comprehends the chief sources of air pollution which are always present in inhabited rooms. The use of the term in this restricted sense enables us to treat the subject with greater scientific accuracy and precision, since the data entering into the question are quite constant and well defined. The impurities thrown off by the human body in a definite time, and the limit of impurity consistent with the maintenance of perfect health being approximately known, it is



not difficult to discover what quantity of fresh air must be supplied to each individual per hour in order that the standard of maximum impurity shall not be exceeded, and also the amount of cubic air-space required to permit of the requisite supply of air without producing perceptible draughts. With a knowledge of the conditions necessary for overcoming the impurities of respiration and transpiration so as to maintain the air of a quality adapted to the requirements of perfect health, it is easy to provide for other circumstances which may demand a more liberal supply of air in order to maintain the standard of purity. For example, the products of combustion of fires and lights (particularly the latter, as special outlets are made for the escape of smoke from fires), if allowed to escape in the room, will make a larger supply of air necessary. It should be borne in mind that fires and lights consume the oxygen of the air, and thereby lessen its most essential element.

It is important to observe that the amount of air required in sickness is much greater than that necessary in health. In some cases of sickness the emanations from the body are so offensive that hardly any reasonable amount of air is sufficient to remove the odor. Other contingencies may arise in which special provision for fresh air is required; but most of these cases lie within the field of public hygiene, which is not a part of our subject. When these accidental or remedial causes of air-deterioration are encountered in dwelling-houses, it is the wiser plan to search for them and have them promptly removed, rather than waste our energies on means of ventilation.

#### **Changes in the Air Produced by Respiration and Transpiration.**

According to Dr. de Chaumont, the changes produced by respiration and transpiration are the following:

1. The oxygen is greatly diminished.
2. The carbonic acid is largely increased.
3. A large amount of watery vapor is produced.
4. There is a considerable evolution of ammonia and organic matter.
5. A notable amount of suspended matter is set free, consisting of epithelium and molecular and cellular matter, in a more or less active condition. At the same time portions of the epithelium are constantly being given off from the skin, and even pus-cells from suppurating surfaces.

A man breathes about fifteen or sixteen times a minutes, discharging at each expiration from twenty to thirty cubic inches of air, so that in the course of a day about 350 cubic feet of air pass through the lungs. This air is warmed and loaded with watery vapor and gains a large amount of carbonic acid (nearly five per cent.), while the quantity of oxygen is greatly diminished (about five per cent.). The oxygen is diminished in direct ratio to the consumption of carbon and hydrogen in the system.

The average amount of carbonic acid exhaled by an adult is about six-tenths of a cubic foot in each hour, or from twelve to sixteen cubic feet in the twenty-four hours. To this must be added the carbonic acid emitted from the skin, which is an undetermined quantity. Of course, the amount varies with the age, sex, and weight. The carbonic acid of respiration diffuses itself equably through the air of the room and may be gotten rid of very rapidly by opening the windows. It is not so with the organic matter and watery vapor, which does not appear to diffuse equally nor rapidly through the air of the room.

The amount of vapor discharged by the skin and lungs has been estimated at about thirty ounces per day, or about 550 grains per hour; and this requires, on an average, about 200 cubic feet of air to retain it in a state of vapor. Dr. de Chaumont estimates that 2,000 people will give off in two hours about seventeen gallons of water from the skin and lungs. The quantity of vapor, of course, varies according to the temperature and hygrometric condition of the atmosphere. It must be remembered that the capacity of the air for moisture increases very rapidly with the temperature. At a high temperature there is a greater transpiration, and a less quantity of air is required to hold in suspension the vapor thus given off.

The organic matter from the lungs and skin forms the most important impurity in the air of inhabited rooms. The precise amount of this matter has never been determined, nor is it possible at the present time to estimate it correctly. It consists of "small particles of epithelium and fatty matters detached from the skin and mouth, and partly of organic vapors given off from the lungs and mouth." When passed through water it renders it very offensive. It is nitrogenous and oxidizable, and probably in combination with water, as substances which readily imbibe moisture absorb it most easily. Wool, feathers, damp walls, and moist paper absorb it quite freely. It is in all probability not a gas, but molecular in composition, and may be said to float about the room in clouds, evidently not being equally diffused in the air. It is the cause of the disagreeable odor in the air of rooms otherwise pure, but vitiated by respiration, and, on account of its want of diffusibility, difficult to get rid of, even after the ordinary means of ventilation have been applied. The air of the sick-room contains this matter in excess, associated with pus-cells and other emanations from the body. Dr. Wilson states that as much as forty-six per cent. of organic matter has been found in plaster taken from the walls of a hospital ward in Paris.

#### Carbonic Acid a Measure of Other Impurities in the Air.

It has been found by experiment that the amount of organic matter in the air of a room vitiated by respiration only, increases in direct ratio with the carbonic acid. The carbonic acid is not of itself of the greatest

importance; but, as its quantity can be easily ascertained, it forms a very convenient means of estimating the poisonous organic matters which are associated with it. Its increase shows to what extent the existing air has been polluted by the exhalations from the body. If there is a great deal of carbonic acid present, it may be inferred that the other impurities, of a more injurious character, are proportionally increased; and as it is not easy to determine directly the quantity of the organic matter and vapors, the carbonic acid furnishes a convenient index for estimating the amount. It has been ascertained by numerous examinations, that the organic matter is generally perceptible to the sense of smell when the carbonic acid reaches six-tenths of one volume in 1,000 volumes of room-air, and this has been taken as the limit of impurity. When it reaches one volume in 1,000 volumes, the odor is very strong, and the air is said to be "extremely close." The average amount of carbonic acid in the outer air is four-tenths of a volume in 1,000. When to this quantity (which is the initial or normal quantity) is added two-tenths of a volume in 1,000, as the respiratory carbonic acid, the maximum limit of impurity, or six-tenths of a volume in 1,000, is reached. When, therefore, the carbonic acid in the air of an inhabited room (when man is its only source) does not exceed two-tenths of a volume in 1,000,—the maximum amount of respiratory impurity admissible,—the air-space may be said to be properly ventilated.

### **The Effects of Breathing Impure Air.**

The nature of the impurities imparted to the air by respiration and transpiration have already been inquired into; it remains to point out their effects upon the human system. The results which may be produced by breathing air rendered foul by exhalations from the body have long been recognized, but the practical sequence of such knowledge does not appear to have made a sufficient impression upon the public mind. Imperfect ventilation is the constant condition encountered in all classes of residences. In the houses of the poor it is not expected that the proper attention will be given to this vital question. With a too limited air-space to begin with, the conditions are made worse by aversion to proper renewal of air, especially in the cold season when a change of atmosphere causes a lowering of temperature and necessitates a larger supply of fuel to maintain comfort. The ventilation of the overcrowded rooms of the lower classes is bad enough in the summer season when the windows and doors remain open, but in cold weather when the windows and doors are kept closed and every effort is made to obstruct the entrance of cold air, and when, in addition, the pores of the walls become choked up by moisture condensed from the air of the house, it is very much worse. "Bad doors and windows, unmended window-panes, remain often the only routes for ventilation. Poor people, in complaining of them, are



not aware that they are the smaller of many evils and a defect without which they might suffer still more." The gift of fuel, under such circumstances, not only contributes to the comfort of the poor, but indirectly supplies the means whereby fresh air, nature's bountiful gift, may be obtained.

But it is not alone in the abodes of poverty that this evil is encountered. If we inquire into the condition of the atmosphere in public houses, in theatres, churches, concert-halls, court-houses, and schools, or of ball-rooms, drawing-rooms, and bed-rooms in the elegant and carefully appointed houses of the rich, as well as the comfortable-looking homes of those in fair circumstances, the evidence is everywhere apparent that the subject of ventilation is too little heeded, in very many cases entirely ignored. It is fortunate for our well-being that only a portion of our lives is spent within doors. Ill-ventilation being the general condition, and a very constant one, Dr. de Chaumont has felt justified in connecting it with the prevailing diseases, which are the chief sources of mortality. He states, after a very critical inquiry into the subject, that we are entitled to connect the great death-rate from heart-disease, atrophy, and debility and convulsions, and particularly that due to consumption and respiratory complaints, with one constant condition affecting the whole community, namely, breathing impure air. This observer is not the only one who has asserted, upon apparently good grounds, that breathing vitiated air contributes largely to the formidable mortality from these diseases. The evidence on this point is abundant, and the fact may now be said to be well recognized.

Says Dr. Parkes: The now well-known fact of the great prevalence of phthisis in most of the European armies (French, Prussian, Russian, Belgian, and English) can scarcely be accounted for in any other way than by supposing the vitiated atmosphere of the barrack-room to be chiefly in fault. This is the conclusion arrived at by the Army Sanitary Commissioners in their celebrated report published in 1858. Before that investigation, the air-space allowed to each soldier in the barracks of the Foot Guards was only 331 cubic feet, and the mortality from consumption was as high as 13.8 per 1,000. In the Horse Guards, on the other hand, the space per man amounted to 572 cubic feet, and the mortality from consumption did not exceed 7.3 per 1,000. No matter how varied the stations of the army, or how beautiful or healthy the climate, consumption prevailed to an extraordinary extent; and the only condition common to all these places was the vitiated atmosphere which the barrack-system everywhere produced. As the result of this inquiry, the commissioners recommended that the cubic air-space per man should be increased, and the ventilation improved. Since the adoption of these recommendations there has been a very decided decrease in the cases of consumption, while the only notable change that has taken place at these stations is the im-

provement in the condition of the air. The excessive mortality from consumption among the men of the royal navy and of the merchant marine has likewise been attributed to defective ventilation.

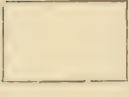
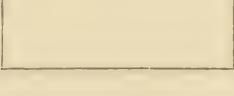
In a prison at Vienna, where the ventilation was notoriously bad, the mortality from consumption was 51.4 per 1,000, while in a better ventilated prison the deaths from this disease amounted to only 7.9 per 1,000. In the Dublin House of Industry, before an improved system of ventilation was introduced, the mortality from scrofula was so formidable that the disease was thought to be contagious. Other instances of a like nature might be cited to prove that phthisis is very prevalent under the circumstance of breathing air rendered impure by respiration. As before remarked, not only phthisis, but other lung diseases, such as bronchitis and pneumonia, appear to be more common under conditions which permit of the constant breathing of air vitiated by the organic matter and particles thrown off from the body.

Crowding and foul air tend to increase the virulence and cause a more rapid spread of all the so-called zymotic diseases, particularly typhus fever, small-pox, scarlet fever, and measles. This may be accounted for, partly, by the accumulation of the specific poison, or by the favorable conditions for the propagation of the virus, or it may be by the debilitating influences of the foul air, by which the system is rendered less able to resist disease.

The injurious influences and fatal results of overcrowding and breathing bad air are exemplified by the notorious instance of the "Black Hole of Calcutta." Of 146 individuals confined for ten hours in a small cell, only twenty-three were taken out alive. Many of these, who could scarcely be said to be alive, afterward succumbed to a fatal fever. Another example is that of the steamer *Londonderry*, which left Sligo for Liverpool December 2, 1848. Stormy weather coming on, the captain of the vessel forced 150 of the steerage passengers into a cabin, which was eighteen feet by eleven feet and seven feet high, and battened down the hatches, and covered them with tarpaulin. In the morning, when the cabin was opened, seventy of the passengers were found dead, and several were expiring.

Jail or typhus fever is known to have originated from overcrowding, and breathing deteriorated air. Of some such nature was the disease which gave celebrity to the Black Assizes of Oxford in the sixteenth century. The pestiferous exhalations from the prisoners, who had been confined in an ill-ventilated jail, caused most of the judges, counsel, and jury, and others in court, to be attacked with a putrid fever, which spread to the surrounding population, and produced serious consequences. The epidemic of typhus fever which prevailed extensively in the town of Merthyr-Tydvil, in 1870, was attributed by Dr. Buchanan to overcrowding and want of proper ventilation in the houses of the poor.

The following table, given by Guy and quoted by Dr. Lincoln of Boston, serves to illustrate the effects of various degrees of overcrowding in certain celebrated cases:

| Effects of Overcrowding.            |                                                                                     |                                                                                                                                                               |
|-------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cubic feet.                         |                                                                                     |                                                                                                                                                               |
| 20                                  |    | Black Hole, Calcutta. { Of 146 persons, 23 left alive after ten hours. Fatal fever in survivors.                                                              |
| 30<br>to<br>60                      |    | Marlborough House, Peckham, City of London, Union Work-house. { 130 fever patients sent to London Fever Hospital in one year; one-fifth of total in Hospital. |
| 52                                  |    | Church Lane, St. Giles. { Great mortality among children and adults. Fever. Cholera.                                                                          |
| 84                                  |    | Village in Dorsetshire. Fatal Fever.                                                                                                                          |
| 100                                 |    | Parish house near Launceston. Cholera.                                                                                                                        |
| 136                                 |  | Drouet's Establishment for Pauper Children, at Tooting, January, 1849. { 170 deaths from cholera in three weeks.                                              |
| 170                                 |  | Cambridge Town, Bridewell, 1774. Jail fever.                                                                                                                  |
| 202                                 |  | Printing Office. Consumption.                                                                                                                                 |
| 288                                 |  | Christchurch Workhouse, Children's Sick Ward, 1848.* { Gangrene of the mouth.                                                                                 |
| Prison allowance, 1,000 cubic feet. |                                                                                     |                                                                                                                                                               |

\* In one ward 132 cubic feet. 288 cubic feet is the average of a number of wards.



The exhalations from the sick render the confined air still more poisonous. In hospitals, unless provision is made for this additional source of impurity, the results are sure to be disastrous. Not only is convalescence retarded, but the virulence of disease is greatly intensified. When the impurity reaches a certain point, there is danger of gangrene and erysipelas, which is apt to spread, especially in surgical wards. The presence of these diseases may be taken as a very reliable indication of a foul state of the air of the wards. On the other hand, when the freest ventilation has been maintained, or where resort has been had to tents or open-air treatment, these disastrous consequences have been entirely prevented, and the treatment of disease has been most satisfactory.

But the ill effects of want of ventilation are not only seen in the production and aggravation of disease; the slow and insidious effects of continuously breathing air, even moderately impure, are recognized in the general lowering of the tone of the system as indicated by headache, inertness, and even gastric disturbance. Persons accustomed to breathing air containing fetid organic matter, excess of watery vapor, and carbonic acid produced by respiration, soon become pale, lose their appetite, and fail in their strength and spirits. Under these circumstances they are in a condition that predisposes to disease. How often is it that we ascribe the common occurrence of "catching cold" to transitions of temperature and exposure to weather, when the true cause is a lowered vitality produced by constantly inhaling impure air, which renders the system susceptible to the slightest influences!

It is therefore evident, that crowding and foul air tend very materially to produce and aggravate disease, and very powerfully to increase the spread of all zymotic affections; that breathing impure air is one of the prominent causes of the excessive mortality from diseases which commonly afflict mankind; that this cause is widespread and potent in undermining the health, in impairing the tone of the system and in reducing the capacity for productive work, thereby entailing upon the rich an unfitness to properly enjoy life, and upon the poor an inability to earn a livelihood, with the attendant risk of drifting into pauperism, mendicancy, and even crime.

The effects upon health produced by habitually breathing air vitiated by the exhalations from the body, and from other sources, being of such grave importance and so generally encountered in the habitations of the people, rich as well as poor, the question at issue naturally addresses itself to the remedy of the conditions which combine to cause this great universal evil, namely, poisoning by impure air. Overcrowding must be prevented, and our dwellings kept supplied with sufficient fresh air to keep them wholesome; that is, the air should be maintained of a quality as nearly like that of the external atmosphere as is possible.

### **The Unventilated Hovels of the Poor, the Haunts of Disease.**

The State and local governments have an important function to perform in behalf of the public interests in clearing out the wretched abodes of the poor, which, under no circumstances, can be made suitable for the needs of their occupants. In streets and courts of thickly populated districts, where the houses are closely set together, with scarcely any intervening air-space, the outer air, which alone can effect purification, is prevented from circulating freely, and therefore the impurities which load the atmosphere of such habitations have not even the advantage of exposure to a purifying medium. Overcrowding and filth, two common conditions in such localities, add to the seriousness of the situation. Dr. Buchanan, an inspector of health for the English local government board, thus describes some of these dreadful places: "In small closed courts, surrounded by high buildings and approached by narrow and perhaps winding gangways, houses of the meanest sort stand, acre after acre of them, with but privies and dust bins to look upon. And surely such cannot be accounted fit for human habitation, while the standard of that humanity is low. Nothing short of a tornado can effectually ventilate these courts; in still weather the atmosphere in them is unchanged and unchangeable. Can it be a matter of surprise that such regions should be the favorite pastures or hunting-grounds of filth-diseases, and that moral, as well as material, deterioration should be invariable accompaniments?"

### **The Prevention of Overcrowding, the Duty of the Local Government.**

The clearing out of these dens of disease, and the construction of habitable homes in their places; the sanitary regulation of the cottages of the poor, by which overcrowding shall be prevented, and an efficient provision made for the removal of used-up air, and for the supply to each home of its proper share of light and fresh air,—are measures directed against this common evil, which it behooves the authorities to undertake in behalf of the public good. So much relates to the duty of the State. The next point to be considered is the supply of fresh air required for the purposes of ventilation.

### **Amount of Fresh Air Required for Ventilation.**

In order to determine the quantity of air required to remove the respiratory impurities caused by healthy persons, it is necessary to have some standard of the purity of air in dwelling-rooms. It is of the first importance that the air about our dwellings should be fresh and pure; and then, by ventilation, our object is to supply this air to our dwellings as freely as possible, so that the within-contained air shall at all times be maintained at a standard as nearly as possible like that of the outside air.

It is, of course, impossible to reach the standard of purity of the outside air, even under the most favorable circumstances, as the amount required to be introduced for the purpose would be infinite. But it has been ascertained by calculation and experiment, that the impurities may be so reduced by ventilation that their continued inhalation, in diluted form, will not be detrimental to health. To what extent, then, may we pollute and change the air of a room, by respiration and transpiration, without the risk of injuring our health; or, in other words, what is the limit of maximum impurity consistent with the maintenance of health? It has already been seen, that the increase in the amount of carbonic acid in the air is practically in direct ratio with the increase of the organic impurities, and therefore the carbonic acid forms a very reliable index to the amount of the other impurities associated with it; provided, however, that the only source of impurities is that derived from the human exhalations. Carbonic acid, in excessive quantity, is poisonous; but, as ordinarily encountered, it is not looked upon as an important impurity. Its greatest significance lies in the fact, that it is a convenient means of estimating the other and more poisonous matters that are simultaneously and proportionately imparted to the air in consequence of respiration and perspiration. Its increase shows to what extent the air of the room has already passed through the lungs of the occupants.

#### Standard of Permissible Impurity of Air in Enclosed Spaces.

The amount of carbonic acid in normal air averages four-tenths of a volume in 1,000 volumes of air, or four volumes in 10,000; and it has been determined by the best authorities, that this amount ought not to be increased beyond six-tenths of a volume in 1,000. When present in excess of this amount, the air of an inhabited room becomes perceptibly impure. The standard of maximum impurity, as generally accepted, is therefore six-tenths of a volume in 1,000—that is, four-tenths of a volume in the original air, and an additional two-tenths derived from respiration. As long as this ratio is not exceeded, the air-space may be said to be properly ventilated. It may be observed that this rule is somewhat arbitrary, since it is impossible to fix with accuracy the limits which divide good from bad air, and to show, by any direct evidence, the injurious effects upon health of a greater amount of impurity than that indicated by the standard selected. But, as Dr. Parkes observes, such a standard must be adopted; first, on the general evidence that large aerial impurities are decidedly hurtful, and that smaller amounts may be presumed to be so in proportion, although we cannot measure their action; and secondly, on the fact that we have an obvious and simple measure in the effect produced on the senses, which gives us a practical line of demarkation we could not otherwise obtain.



How shall this standard for measuring the amount of air-deterioration be made available? Dr. de Chaumont and other observers have proposed to accept as a good and sufficiently ventilated air, one that shall present to the sense of smell no perceptible difference from the external air. A very large number of observations made by Dr. de Chaumont establish the conclusion, that no appreciable smell of organic matter from respiratory impurities is noticeable until the carbonic acid reaches the limit of six-tenths of a volume in 1,000 volumes of air, or six volumes in 10,000. When present in excess of this limit, the air was characterized as "rather close," "close," or "extremely close," in proportion to the increase in the amount of the carbonic acid. In order to properly apply this test, the room should be entered as directly as possible from the fresh outside air; for, after the observer has been in the room for a short time, the sense of smell becomes dulled, and the odor imperceptible. A very offensive atmosphere, which would call for instant remark if entered quickly from the fresh outside air, may pass unobserved by one confined in it for a length of time. The following is a tabular statement of the results obtained by Dr. de Chaumont:

|                                                                                                                                                                 | 1. FRESH, or not differing sensibly from the outer air. | 2. RATHER CLOSE.—Organic matter becoming perceptible | 3. CLOSE.—Organic matter disagreeable. | 4. VERY CLOSE.—Organic matter offensive and oppressive; limit of differentiation by the sense. |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------------------------|
| Mean carbonic acid per 1,000 vols. reduced to 60° Cent. (= 32° F.), due to respiratory impurity.                                                                | 0.1943                                                  | 0.4132                                               | 0.6708                                 | 0.9054                                                                                         |
| Total carbonic acid per 1,000 vols. obtained by adding to the respiratory impurity 0.4 per 1,000 vols. as the average amount of carbonic acid in the outer air. | 0.5943                                                  | 0.8132                                               | 1.0708                                 | 1.3054                                                                                         |

It will be noticed that the smell of organic matter is, on an average, not perceptible until the ratio of the total amount of carbonic acid present reaches six-tenths of a volume in 1,000; and, therefore, those conditions which keep the impurities within this limit are sufficient for maintaining good ventilation. This, then, is the commonly accepted limit which should not be overstepped. For practical purposes, the evidences of the senses may be relied on for determining this limit; but when the results are distrusted, and a more accurate and thorough examination of the air is required, resort must be had to chemical examination, a description of which it is not essential for our purposes to enter upon. However, a very ready method of testing the quality of the air, as given by Dr. Angus Smith, may be mentioned. Half an ounce of lime-water shaken up in a ten-and-a-half-ounce bottle filled with air of the room to be tested gives no precipitate with air containing carbonic acid in the proportion of

six-tenths of a volume in 1,000, and the same quantity of lime-water in an eight-ounce bottle gives no precipitate if the air contains less than eight-tenths of a volume of carbonic acid in 1,000 volumes.

The same observer shows how, by trusting to the test of our senses, we practically endorse the correctness of the standard adopted. He remarks that we all avoid an atmosphere containing one volume of carbonic acid per 1,000 in crowded rooms; and the experience of civilized men is, that it is not only odious, but unwholesome. When people speak of good ventilation they mean, without knowing it, air with less than seven-tenths of a volume of carbonic acid per 1,000. We must not conclude that because the quantity of carbonic acid is small, the effect is small; the conclusion is rather that minute changes in the amount of this acid are indications of occurrences of the highest importance.

**Amount of Fresh Air Required to Remove the Respiratory Impurities of Healthy Persons.**

Having arrived at the standard of purity, the next thing to determine, is the supply of fresh air required per head in each hour to maintain the air of a room within the limits of this standard. It has already been stated that an adult man gives off from his body six-tenths of a cubic foot of carbonic acid in an hour, and the amount of carbonic acid naturally in the air being four-tenths of a volume in 1,000, it is determined, by calculation, that the amount of fresh air required to be supplied per hour to each individual, in order to preserve the air-space in a state of freshness, should be 3,000 cubic feet. The following useful table is taken from Parkes' Hygiene. The parts of a volume are given in decimals:

TABLE TO SHOW THE DEGREE OF CONTAMINATION OF THE AIR (in Terms of Carbonic Acid) BY RESPIRATION, and the amount of air necessary to dilute to a given standard of .6 per 1,000 volumes of air, of which .4 is carbonic acid naturally existing, and .2 is from respiration. In the table a deduction is made of the initial .4 volumes of carbonic acid per 1,000, for the sake of clearness.

| Amount of cubic space<br>(=breathing space, for one<br>man in cubic feet. | Ratio per 1,000 of carbonic<br>acid from respiration at the<br>end of one hour, if there<br>has been no change of air. | Amount of air necessary to<br>dilute to standard of .2, or,<br>including the initial car-<br>bonic acid, of .6 per 1,000<br>volumes, during the first<br>hour. | Amount necessary to dilute<br>to the given standard<br>every hour after the first. |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 100                                                                       | 6.00                                                                                                                   | 2900                                                                                                                                                           | 3000                                                                               |
| 200                                                                       | 3.00                                                                                                                   | 2800                                                                                                                                                           | 3000                                                                               |
| 300                                                                       | 2.00                                                                                                                   | 2700                                                                                                                                                           | 3000                                                                               |
| 400                                                                       | 1.50                                                                                                                   | 2600                                                                                                                                                           | 3000                                                                               |
| 500                                                                       | 1.20                                                                                                                   | 2500                                                                                                                                                           | 3000                                                                               |
| 600                                                                       | 1.00                                                                                                                   | 2400                                                                                                                                                           | 3000                                                                               |
| 700                                                                       | 0.85                                                                                                                   | 2300                                                                                                                                                           | 3000                                                                               |
| 800                                                                       | 0.75                                                                                                                   | 2200                                                                                                                                                           | 3000                                                                               |
| 900                                                                       | 0.66                                                                                                                   | 2100                                                                                                                                                           | 3000                                                                               |
| 1000                                                                      | 0.60                                                                                                                   | 2000                                                                                                                                                           | 3000                                                                               |

The initial carbonic acid—that naturally contained in the air—has been left out of the table for the sake of simplicity. The air of the room would actually contain .4 volumes per 1,000 more of this gas. In a room of 100 cubic feet there would be at the end of one hour .64 volumes per 100, or 6.40 per 1,000, and so on.

If the standard of purity, namely, six-tenths of a volume of carbonic acid in 1,000 volumes of air, is deemed too high, as in the case of women and children, who vitiate the air less rapidly, or as involving too great a cost, and a lower rate be taken, the amount of fresh air required would be proportionally less. If a standard of seven-tenths, eight-tenths, or even nine-tenths, be assumed as satisfactory, the corresponding amounts of air necessary would be respectively 2,000, 1,500, and 1,200 cubic feet per head for each person.

It is known that from fourteen to eighteen cubic feet of air pass through the lungs of a person per hour, or between 350 and 450 cubic feet in the day, and therefore a supply of 3,000 cubic feet of fresh air per hour for one person, might be considered as an extraordinary allowance. But it has been shown by direct experiment, that this quantity is not in excess of what is absolutely indispensable. A number of very competent observers, such as Parkes, de Chaumont, Morin, and Roth and Lex have made very careful experiments, the results of which fairly agree with those arrived at by mathematical calculation.

In fixing the amount of fresh air required, it is assumed that we are dealing only with the respirations of healthy persons when at perfect rest. Of course, when persons are engaged in active work, an increased amount of impurity is evolved, and therefore the supply of air must be correspondingly increased. From 4,000 to 5,000 cubic feet per head in the hour may be required in ordinary work-rooms, to keep the air up to the established standard of purity. In unwholesome trades, nothing short of an unlimited supply of air can be considered satisfactory.

### The Quantity of Air Required for the Sick.

It need hardly be said that the sick require a more liberal supply of air than the healthy. In some diseases, the organic matter emitted from the body is of so fetid a character as to require almost unlimited ventilation to remove the odor. For the sake of comparison, Dr. de Chaumont made some experiments in barracks, among healthy men, and in hospitals, and he found that it took nearly *one-third* more air to keep the atmosphere sweet in hospitals. He remarks: "We may safely lay it down that in ordinary cases no hospital ward ought to have less than 4,000 cubic feet per head per hour, and that in cases of zymotic or epidemic disease the amount ought to be greatly increased; indeed, practically, the amount ought to be unlimited, so that many kinds of disease might be advan-



tageously treated in the open air. This is proved by the great success of tent hospitals, both in time of war and in time of peace."

These suggestions, with some modification, apply in the case of sickness in the private home. The hourly supply of air to the sick man should be largely increased over that deemed sufficient for a person in health. It should not be forgotten that the benefits intended to be conveyed by an increased ventilation are often prevented by the thoughtless presence in the sick-chamber of an unnecessary number of persons, who help devitalize the air, and add to its impurity.

### **The Quantity of Air Required for Lights.**

The burning of lights vitiates a large amount of air, if, as is commonly the case, the products of combustion are allowed to pass into the room. It is therefore necessary to augment the supply of fresh air, or to provide special channels for the escape of the products of combustion. A small gas-burner using about three cubic feet of gas per hour, will consume from ten to twelve cubic feet of gas during an evening, and will destroy the oxygen of eighty to ninety-six cubic feet of air in combustion. According to Wolpert, each cubic foot of gas burned, will require the introduction of 1,800 cubic feet of air to properly dilute the products of combustion; therefore, 18,000 to 21,600 cubic feet of air must be introduced for this purpose in the three or four hours, unless provision is made for the escape of the products of combustion. This allowance of air for an ordinary gas-burner is about the amount required for two persons.

Attention is often directed to the greater oppressiveness caused by burning gas as compared with other lights, and it has been supposed that gas produces more carbonic acid, and is more injurious. This is not the fact, if the same illuminating effect is obtained in each case; indeed, experiments have been made which indicate that the atmosphere of a confined room lighted by coal-gas would require less air to keep it pure than when lighted by any form of candles, the power of illumination being equal. But the true reason of the effects complained of is to be found in the habit of burning so much more gas, people not being satisfied with the dim light of the candle; and, therefore, the practice of using gas requires that the products of combustion shall be removed by a special channel. In the country, where gas is seldom burned, and where a less amount of illumination is satisfactory, it is seldom necessary, in estimating the amount of air required, to take into consideration the effects produced by illuminants.

### **Amount of Cubic Space Necessary for Ventilation.**

A large supply of air is required to preserve the air of an inhabited room in a wholesome state of freshness. The amount has been fixed at 3,000 cubic feet per hour for each adult, healthy man. In order to secure

the required change of air without perceptible, or at least uncomfortable, currents or draughts, a certain amount of cubic air-space is necessary. The size of the room, or the cubic air-space, will depend on the means by which the necessary amount of air is supplied. If the room is small, the air must be changed more frequently than when it is large, and the rate at which the air passes through the space will necessarily be more rapid, and the chances of uncomfortable draughts more imminent. If, for example, the space allowed be only 100 cubic feet, the contained air will have to be renewed thirty times in an hour to supply the 3,000 cubic feet allotted; whereas, with a space of 1,000 cubic feet, the air will need changing only three times in an hour to maintain the standard of purity. In this climate it is not feasible to change the air more than three or four times in an hour without causing draughts, unless the very best mechanical means are employed. It has therefore been determined that each person should have, as a minimum allowance, from 750 to 1,000 cubic feet of initial air-space, which will permit of a change of air four or three times in an hour without discomfort. These figures are based upon the assumption that six-tenths of a volume of carbonic acid per 1,000 is the correct standard of purity of the air of an occupied room. Any modification of this standard would, of course, make a change in this allowance.

A very much smaller space than that designated as the standard can, doubtless, be efficiently ventilated, as has been demonstrated by the experiments of Prof. Pettenkofer in his own room at Munich. By using the best mechanical contrivances and warmed air, he succeeded in renewing the air in the chamber with an air-space of only 424 cubic feet six times in an hour without creating any perceptible movement in the air. If the cost is a matter of no concern, there can be no doubt, that, with proper appliances, a very much smaller space even than that just described can be comfortably ventilated; but with natural ventilation it need not be attempted. For most dwellings, the use of contrivances such as have been alluded to scarcely enter into the question. In the first place, they are too costly; and then, again, the care and attention required is apt to be neglected, and if, by chance, the mechanism should become arrested, the air of the apartments becomes more quickly polluted by reason of the more limited space. But the main objection to a small air-space is the impracticability of renewing the air sufficiently often without causing draught. In ventilating small spaces, the inlets are so near the person occupying the room as to make a draught unavoidable. In exemplification of this fact, Dr. Wilson has cited the case of prisons in which convicts are confined in cells during rest, the air-space of which seldom exceeds 200 cubic feet. To avoid the unpleasant effects of these draughts, the prisoners frequently block up the inlets as best they can, and thus obstruct ventilation with serious consequences. He remarks, that, "so far as his experience goes, it is difficult, even with the aid of a well-devised



plan of ventilation, to supply the necessary amount of fresh air per head per hour without creating perceptible draughts occasionally, if the space be less than 600 cubic feet. I have further satisfied myself that with the same artificial appliances and arrangements, the air contained in small occupied spaces becomes much more impure than in large spaces."

The objection to a small air-space does not lie entirely in the disagreeable effects of currents of air, which are unavoidable, if an attempt be made to supply the necessary amount of air from without: there is beyond this the difficulty of obtaining a uniform diffusion of the air when the inlet and outlet are close together and a current is established, since a large amount of air passes directly out before being properly distributed, and is, therefore, of little advantage. With an air-space of 1,000 cubic feet, for example, the problem of ventilation becomes much easier. The current of fresh air is more easily broken up and mixes more readily with the larger volume of air in the room, and the occupant, being further from the opening, does not perceive the movement of the air. It may be incidentally remarked, that a large space offers greater facility for insensible ventilation, since the larger wall-space and more numerous windows permit of a greater change of air, and thus, with equal means for ventilation, a large room will have a less degree of impurity than a small one. To a certain extent provision can be made for the requisite amount of air by the size of the room, from the fact that the air is longer in reaching the limit of admissible impurity in a large space than in a small one, but this can never be possible for any length of time; and it becomes absolutely necessary to renew the air, from time to time, however large the space may be. Dr. de Chaumont gives the following results of an experiment to determine the length of time it would take to bring the air to the limit of permissible impurity (six-tenths per 1,000 of carbonic acid, initial and respiratory) in unventilated air-spaces of different sizes:

|                               |           |                     |
|-------------------------------|-----------|---------------------|
| One man in 10,000 cubic feet, | . . . . . | 3 hours 20 minutes. |
| " " " 5,000 " "               | . . . . . | 1 hour 40 "         |
| " " " 1,000 " "               | . . . . . | 20 "                |
| " " " 600 " "                 | . . . . . | 12 "                |
| " " " 200 " "                 | . . . . . | 4 "                 |
| " " " 50 " "                  | . . . . . | 1 minute.           |
| " " " 30 " "                  | . . . . . | 36 seconds.         |

The larger amounts mentioned are scarcely ever met with: it is more commonly the case that the air-space is less than the standard selected (750 to 1,000 cubic feet). Even with an air-space of 10,000 cubic feet, the limit of impurity would be reached in a little over three hours, and thereafter 3,000 cubic feet of fresh air would be required each hour to keep the air in a condition of freshness, the hourly supply of air being the same for a space of 100 or any number of cubic feet. The error of supposing that the cubic space may take the place of a change of air, so that by



providing a large room less fresh air will be required, is a very common one, and should be carefully guarded against. It is very unwise to attempt to make up for bad ventilation by providing increased cubic space, particularly if this increase be in the height of the room and not in floor-space. The air above a certain height is of little advantage, if the floor-space be too limited; for an enclosure relatively unlimited in height, but contracted about a man, would suffocate him. Dr. Corfield gives, as an extreme example, that of a man standing on a square foot of ground, with walls 3,000 feet high all around him, who would be in 3,000 cubic feet of space, but it is evident that he could not survive in it. It has become the custom, for purposes of ventilation, to disregard the heights of rooms above twelve feet. Under no circumstances, then, can a large supply of fresh air be dispensed with and the habitation remain healthy, and no arrangement whatever can take the place of that air.

A large space does not require so frequent and rapid a renewal of the air as a small space, but the greater expense of maintaining a comfortable temperature with the necessary ventilation may lead to a dangerous exclusion of the outer air. On the other hand, a small space will necessitate a more frequent and rapid change of air, and if this perfect renewal takes place more frequently than three or four times in the hour, the movement of the air causes a draught and becomes uncomfortable. Between these two extremes lies the practical mean, which requires that the cubic space shall be neither too large nor too small, but sufficient only for maintaining perfect ventilation without perceptible movement of the air, or draught.

It has been stated, that, with the ordinary means of ventilation, the amount of space required for an adult healthy man is 1,000 cubic feet; but as women and children give off a less amount of impurities, it might be surmised that for them a smaller space would be adequate. As the difference is not great, it would be unwise and confusing to alter the rule, especially as the advantage is in their favor. If any reduction be made, it should apply only to the very young.

It may be considered, by some, that so large a cubic air-space as 1,000 feet is extravagant and unnecessary, and not at all practicable. That it is in excess of what is generally obtained is no doubt true. In the case of the poorer classes, it is seldom that an air-space exceeding 250 cubic feet is encountered. When poverty pinches, overcrowding is an inevitable result. So, too, with the artisan class, the allowance per head is apt to be low. But the results of this condition are only too likely to declare themselves in an increased rate of mortality. As Dr. Parkes observes, "after all, the question is, not what is likely to be done, but what ought to be done." Foul air is the poison of life which people take too willingly, because its effects are slow and insidious, but none the less certain. A proper standard must be selected, and the people educated up to it, otherwise, no improvement need be expected.

For the sick, it is advisable to extend the allowance of air-space ; for, be it remembered, there are other impurities besides those due to respiration, which require to be taken into consideration. It is usual to advise a large, airy room for the sick, especially when the disease is of an infectious character, as the emanations from the body rapidly pollute the air, to the detriment of the patient and attendants, unless provision be made for the immediate dilution of the impurities by an ample distribution of air without draughts, which is more likely to be secured in a large room.

### **The Air Supplied Should be from a Pure Source.**

In fixing the amount of air required per head per hour for the purposes of ventilation, it is assumed that the supply obtained is of normal quality, that is, air containing, on an average, four-tenths of a volume of carbonic acid in 1,000 volumes. It is a fortunate circumstance that the external air maintains a remarkable uniformity of composition, the variations even in thickly-populated places not being very great. It is from this homogeneous atmosphere that we are to draw our supply for ventilation. The caution is to be observed to secure this air in its originally pure condition, or as pure as possible under given circumstances, and not after it has become polluted from any one of innumerable sources which so frequently exist in and about the house. How often is it that the air about houses, defiled by neglected heaps of filth, by collections of stale garbage, by foul, unventilated cesspools, and by general untidiness of the surroundings, is wafted or drawn within the enclosure before it has had time to become properly diluted by diffusion and the action of the winds? The inlets of air-ducts are often thoughtlessly placed in too near proximity to sources of foul air, with consequences that can be better imagined than described. Costly appliances are of no avail if the air distributed by them be drawn from an impure source. The recommendation is to remove all such sources of air-pollution, and by thorough cleanliness to maintain the air, as far as possible, in its natural purity ; and, under all circumstances, to make such selection of the position of the inlet to the air-shaft as shall preclude the risk of taking in air from a doubtful source. A very common mode of heating houses is by furnaces placed in the cellar, which draw their supply of air from an opening in the outer wall of the house, or direct from the cellar. The practice of supplying the air-chambers of furnaces, or heaters, from the cellar is a very common one, although it violates a well-established sanitary rule. Cellar-air is generally more or less impure. The sources of impurity are the ground-air, and conditions connected with the situation, construction, and domestic management of this apartment of the house. The ground-air which, in the vicinity of habitations, is especially impure, is in continual intercourse with our houses, except where special provision is made to exclude it. Cellar-air contaminated from this source and supplied to the house cannot be



wholesome. Cellar-air is moreover apt to be damp and musty on account of defects in construction, and from the absence of sunlight and ventilation. Dust from the ash-pit, and ill-smelling odors from neglected stores of provisions, and the want of cleanliness, which is a not uncommon condition, cause the air of cellars to be unfit for distribution throughout the house. Under these circumstances, it is important that the air should be supplied from outside the house by means of a properly constructed flue, provided with a slide to regulate the amount, and having a grating attached to the inlet to keep out vermin and obstructions. The air-ducts should be constructed in a manner to permit of access to their interiors for the purpose of cleansing.

### **The Distribution of the Air.**

The distribution of the air throughout the rooms is a matter of importance, and can be accomplished by proper attention to the arrangement of the openings. As nearly as possible, uniform diffusion ought to be secured, for, by this means, the chance of rebreathing respired air will be greatly diminished. There have been differences of opinion with regard to the relative positions of the inlets and outlets for air. Some have held that the outlets for foul air should be near the floor, so that the air defiled by impurities could be immediately withdrawn and its place supplied by the purer air from above. Under some circumstances this practice may be advised; as, for example, in certain trades and arts in which the impurities from their weight gravitate towards the floor, and in cases where mechanical devices are used for withdrawing the air; but in dwellings, where the impurities of respired air are mainly to contend with and which tend to ascend on account of the temperature, the proper place for the discharge of foul air is near the ceiling.

### **The Most Desirable Temperature and Percentage of Moisture.**

The air of our dwellings must be comfortably warmed; for, as Dr. Russell remarks, people will prefer being poisoned comfortably to thriving in cold air. The temperature of comfort has been fixed at various points by different writers. Dr. de Chaumont fixes a standard temperature at from 63° F. to 65° F. English writers agree pretty generally upon a temperature of from 60° F. to 65° F. This, from an American standpoint, would seem to be too low, and a range of from 65° F. to 70° F., would, in the main, be more satisfactory to our comfort. However, the question is one which must be determined by the sensations of the majority as to comfort. As a rule, those who are well-clothed, well-fed, and who are accustomed to plenty of exercise, require less warmth.

The amount of moisture in the air affects our sensations, and ought to be properly regulated. According to English writers, the relative humidity of the air ought to range between seventy and seventy-five per



cent., and the difference between the dry- and wet-bulb thermometers ought not to be less than  $4^{\circ}$  F., or more than  $6^{\circ}$  F. At a temperature of  $63^{\circ}$  F., the vapor ought not to exceed 4.7 grains per cubic foot, or 5.0 grains at a temperature of  $65^{\circ}$  F. (de Chaumont). In this climate, it is practically almost impossible to maintain this percentage of moisture; and it has been shown that a very much less per cent. of saturation is not inconsistent with a healthful condition of the atmosphere. Wolpert and Pécelet state that fifty per cent. of relative humidity is a proper standard to maintain. Dr. Cowles believes that a low relative humidity produces no discomfort or ill effects. In his report of the results obtained by him in the Boston City Hospital, he states that when the air is maintained in a fresh and pure condition no complaints of any kind were made, even when there was only fifteen to twenty-one per cent. of saturation. When there is much moisture in the air a sensation of chilliness is produced, and the temperature is instinctively increased. This step is taken, without our knowing it, in conformity with the rule that the capacity of air for moisture increases greatly with the temperature. By this provision we are enabled to maintain without difficulty the proper degree of humidity in our rooms, notwithstanding the external air may be cold and excessively humid.

In addition to the vapor from the combustion of lights and from the ordinary procedures of the household, there is a very considerable amount of watery vapor given off from the skin and lungs, which, without proper means of ventilation, tends rapidly to raise the humidity of the air inside the room towards saturation. Dr. de Chaumont estimates that every man gives off from the body each hour enough vapor to raise the humidity from seventy per cent. to saturation in 500 cubic feet at  $60^{\circ}$  F., and to raise it to eighty-two per cent. in 1500 cubic feet. In order to reduce this amount to the proper standard, say seventy-three per cent., it would take 3,000 cubic feet of air saturated at  $50^{\circ}$  F., or 2,000 at ninety-eight per cent. It is thus seen that a large amount of air is required to maintain the proper condition of humidity, and with a cubic air-space of 1,000 feet, it would require 3,000 cubic feet of fresh air per head per hour, the standard amounts which have been generally accepted.

The amount of watery vapor in the air may be determined by wet- and dry-bulb thermometers, a convenient arrangement of which is found in Mason's hygrometer. The wet bulb is covered with a piece of muslin, over which is placed a small piece of absorbent cotton, which dips into a small vessel supplied with distilled water or rain-water. The temperature indicated by the wet bulb is almost always lower than that of the dry bulb, and the difference between them varies according to the amount of vapor present. Relative humidity is a term conveniently used to express comparative dryness or moisture. When the temperature of both bulbs is the same, the air is saturated with moisture, and is assumed to be 100,

and any degree of dryness may be stated as a percentage of this, and can be conveniently ascertained by reference to a table accompanying the instrument, which is calculated from Mr. Glaisher's hygrometrical tables. To save trouble, all that it is necessary to do is to take the temperature of the dry bulb, and the difference between it and that of the wet bulb, and to note in the table the number given at the intersection of the two columns. This number will give the relative humidity.

### Measurement of the Cubic Space.

In order to ascertain the amount of cubic feet of fresh air each person receives per hour, it is necessary to determine the amount of cubic space, and also the amount of movement of the air. The former involves a simple question of mensuration. If the room is square or oblong and the ceiling flat, the three dimensions of length, breadth, and height are simply multiplied together, and the result is the cubic space required. If the room is of irregular shape, with projections, angles, and an arched ceiling, the problem is not so simple, but may be easily solved by use of the ordinary rules of mensuration. The main part of the room should be measured first, and afterward the recesses and spaces containing air, and the results added together. Solid pieces of furniture, bedding, etc., should also be measured, and their cubic contents deducted from the cubic space already determined. It is customary to make an allowance of about ten cubic feet for the bedding of a single bedstead, and of about three cubic feet for the space occupied by the body of a man of average size. No account need be taken of the smaller articles of furniture, as this would be superfluous. The total number of cubic feet thus obtained, divided by the number of persons occupying the room, will give the amount of cubic-air space per head.

### Determination of the Amount of Air Supplied.

In determining the amount of air supplied to a room, the direction of the air-currents must first be inquired into. This may be ascertained by means of smoke disengaged from smouldering cotton-velvet, light pieces of paper, or by feathers. The flame of a candle is frequently used for this purpose; but, as it is only moved by strong currents, it is of no value, except for determining whether a current of air is entering or issuing from an opening.

The direction of the movement of the air being ascertained, all that is necessary is to determine the rate of movement of the air at the outlets, as the amount of air escaping must be the amount supplied; and it is not always an easy matter to find out the actual quantity entering through the inlets. In fact, this is the only direct way in which the fresh-air supply can be properly estimated. Another means of ascertaining the sufficiency, and even the quantity, of fresh air supplied, already alluded



to, is by the carbonic-acid test. A very large amount of air is constantly entering through the pores of the walls, and through cracks and crevices in windows and doors. Professor Pettenkofer found in a room containing 2,650 cubic feet, and with a difference of temperature between the outside and inside of  $9\frac{1}{2}^{\circ}$  F., that the spontaneous ventilation through the free wall amounted to seven cubic feet per hour. The difference between the amount of air entering through the usual inlets and the quantity escaping by the outlets is often found to be very considerable, and may be explained by the reason just assigned.

For measuring the velocity of the air, an instrument called an anemometer is generally used. This little instrument looks like a windmill in miniature. It has four little sails, or vanes, which are driven by the direct action of the current of air, and turn on axes with an endless screw, operating, by means of delicate cogged wheels, an index on a dial-plate. By means of this index, the number of revolutions of the screw, in a given time,—say one minute,—and therefore the space traversed by the vanes, can be definitely ascertained. Dr. Wilson describes the manner of using Mr. Casella's handy little instrument as follows: "The instrument is placed in the air-current, time is called, and the catch moved to set the machinery free. At the end of one minute, two minutes, and so forth,—according to the length of period of observation,—time is again called, and the machinery immediately stopped by means of the catch. The linear dimension of the current is then read off, and if this is multiplied by the sectional area of the opening, the volume of air which has passed through in a given time can be easily calculated in cubic feet. When the instrument is placed in a tube, or shaft, it should be put well in, but not quite in the centre, because the velocity of the current in the centre is greater than at the sides of the tube. Should the shaft be large, the rate of movement ought to be taken at different parts, and the average ascertained. So, also, when the rate of movement is irregular, several observations should be made, and the average of the whole of them will give the approximate velocity of the current." Having thus determined the amount of air discharged per minute, the amount per hour is obtained by multiplying by sixty, and the result divided by the number of persons in the room gives the quantity of air discharged per head by the opening under examination. Other means are used for determining the velocity of the air-currents, but the one described is the most convenient, and perhaps the most accurate.

#### Methods of Supplying the Necessary Quantity of Fresh Air.

Having found out the quantity of fresh air required for the purposes of ventilation, it is necessary, in the next place, to consider the various methods which have been adopted for supplying this amount of air. Ventilation, derived from the Latin word *ventus*, wind, or air set in motion,



depends on the movement of the air. The causes of the motion of the air are the forces which are continually operating in nature, and the forces which are set in action by man. Hence, ventilation is spoken of as either natural or artificial. This division of the subject is used for convenience; but it is not strictly accurate, as the same principles are, to a certain extent, involved in both forms of ventilation.

### Natural Ventilation.

The forces which operate in natural ventilation are gaseous diffusion, winds, and movements of air caused by inequalities of temperature. Natural ventilation, if strictly defined, would be limited to change of air which takes place by means of the windows, doors, and open fire-places, accidental passages in the woodwork, and the pores in the walls; in other words, by means of passages not specially intended for the purpose. It is not proposed to adopt this strict interpretation, but to extend the scope of the term so as to include the assistance derived from the generation of heat, and the provision of special openings.

The forces which act in natural ventilation are those which are to be depended on in changing the air of our dwellings. In some cases it may be necessary to assist these agents by artificial devices. In artificial ventilation the same principles or natural laws must be utilized in bringing about a movement of the air. The motors for changing the air are differences of temperature and motion of the air secured by heat, or wind-fans, or such forces as are continually operating in the atmosphere about us. By these means a disturbance of equilibrium of masses of air can be created, and different degrees of velocity in the motion of the air effected.

Artificial methods of ventilation, in which air is forced in certain directions by the aid of machinery, are seldom applicable to the dwelling-house. Says Dr. Pettenkofer: "Our ordinary dwellings need not be ventilated artificially; we ought never to so crowd them that the natural means of ventilation, as difference of temperature, motion of the air in the open, dry, and porous walls, and temporary assistance by architectural openings, are insufficient to keep undeteriorated what is most essential for our health. With these means there must go hand in hand the greatest cleanliness in all parts of the house, and abstention from all superfluous and avoidable pollution of the air of the house."

### Inadequacy of Diffusion as a Ventilating Power.

The process of diffusion, by which different kinds of gases tend to intermix, can be very little depended on for the purposes of ventilation. Diffusion takes place through bricks and stone; but if the walls be very thick or covered with paint or paper, the permeability is much lessened, and the amount of diffusion may be quite insignificant. Diffusion takes place much more rapidly through crevices around windows and doors

and at the base of shrunken wash-boards, a circumstance which compensates, in some degree, for imperfect carpentry. By diffusion, the gaseous products of respiration and combustion are rapidly distributed throughout the air of a room; but the organic matter, and, most likely, the watery vapor are scarcely affected by it.

### **The Wind a Powerful Ventilating Agent.**

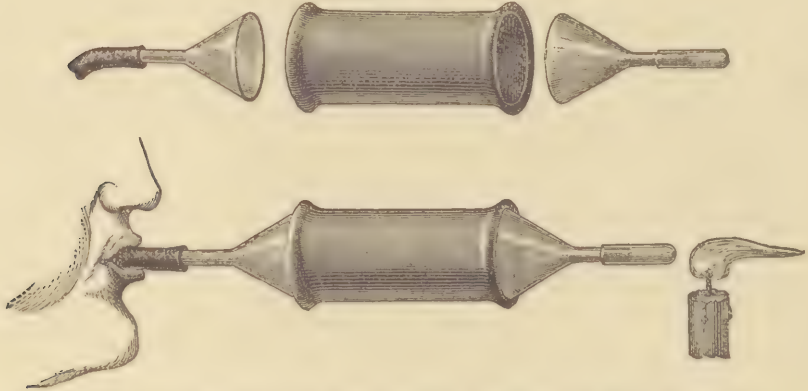
As a ventilating power, the force of the wind is of the greatest service. In the country, where the houses are generally surrounded by pure air, and are exposed to the free action of the wind, the operation of this force contributes very largely to the factors entering into good ventilation. In the closely built-up city, the conditions for utilizing this agency are not so favorable. By opening the windows and doors and allowing the wind to play freely through a room, a powerful ventilating effect is produced. To give some idea of the vastness of the effect produced by this simple means, Dr. Parkes makes the statement, that, if air moving at the almost imperceptible rate of two miles an hour be allowed to pass freely through a space twenty feet wide, the air of the space will be changed 528 times in one hour. For about six months in the year in this climate, the air may be allowed to sweep freely through inhabited rooms; and very little is required to be done in order to secure good ventilation, except to encourage the natural movement of the air by removing obstacles to it.

Houses standing exposed to the wind are apt to have a good circulation of air within them. The atmosphere is never entirely calm, even if it appears so; there is always some motion (though it may be imperceptible), which is more or less serviceable in effecting a change of air within the house. By the force of the wind, air is being continually driven through the many chinks and crevices from which no house is free. A great deal of importance has been attached to the fact that walls are permeable to air, and that through this medium large quantities of air enter a building. If water be placed in prolonged contact with a wall, it will invariably and speedily soak into its pores, and exude in drops from the other side. Now, as air is many hundreds of times lighter and more movable than water, it is quite evident that where water can pass, air will flow much more readily. The following experiment, devised by Pettenkofer, will serve to demonstrate the facility with which air passes through ordinary building materials:

In Fig. 78 is represented a cylindrical piece of mortar, half lime and half sand, five inches by one and two-thirds inches. With the exception of its two ends, the cylinder is covered all over with melted wax, which is impenetrable to air. Upon one end of the cylinder, where the mortar lies free, is fixed, by an air-tight connection, a glass funnel with a tube attached; and upon the other, a similar funnel with a tip to it. By blowing through the tube, the air is forced through the mortar, and

deflects the flame of a candle held near the narrow opening at the other end. Also, by dipping the distal end in water and blowing, the air bubbles up through the water. This could only happen when the mortar

FIG. 78.



DEFLECTION OF A FLAME BY BLOWING THROUGH A CYLINDER OF BRICK OR MORTAR.

is permeable to air. The same experiment may be performed with a piece of wood or a brick.

Märker and Schultze, in their investigations on spontaneous ventilation, have found the amount of air passing through one square yard of free wall per hour, at a difference of temperature of  $9\frac{1}{2}^{\circ}$  F., to be as follows:

|                                    |                 |
|------------------------------------|-----------------|
| Walls of sandstone, . . . . .      | 4.7 cubic feet. |
| " " quarried limestone, . . . . .  | 6.5 " "         |
| " " brick, . . . . .               | 7.9 " "         |
| " " tufaceous limestone, . . . . . | 10.1 " "        |
| " " mud, . . . . .                 | 14.4 " "        |

Painting the interior of walls has the effect of diminishing their permeability to air. Papering has a similar effect, but in a less degree. Some kinds of plaster appear to obstruct the passage of wind. The pores of a wall must be free, in order to allow the air to pass through them. In proportion as they are filled with water, they become impervious to air. A wet wall is practically air-tight, and has this great disadvantage apart from its other injurious effects.

Spontaneous ventilation by perflation is not always to be depended upon, as the air may be stagnant, or its movement uncertain and difficult of regulation. Air moving at the rate of five or six miles an hour, unless warmed, would be so insupportable that it would be excluded. If admitted through small openings, it is very apt to pass directly through the room without properly mixing with the body of the air. As a consequence, there would be uncomfortable draughts. It is of great advantage, however, to have windows on both sides of a house, so that a cross-ventilation



by perflation—a ready and very efficient means of speedily removing impurities from a room—can be established whenever required.

The direct action, or perflating power of the wind, has been utilized for ventilating large houses. In Sylvester's plan, this power is the motive agent. It consists in having a large cowl, that always faces the wind, placed at the top of an air-shaft leading down to a chamber in the basement of the house, where the air can be heated if necessary, and then allowed to ascend by tubes to the different parts of the house, and finally pass out through a tube projecting above the roof, which is fitted with a cowl turning from the wind. In this way the aspirating power of the wind is also utilized. This plan is frequently utilized for ventilating the holds of ships. The aspirating power of the wind is of the greatest assistance in producing currents of air required for the purposes of ventilation. A body of air in motion gives activity to the surrounding air. It not only drives the air before it, but, by creating a partial vacuum, causes the air surrounding its path to move more or less directly towards it. Thus, when the wind blows over the top of a chimney, or a ventilating-shaft, it causes a diminution of pressure in the column of air in the chimney, or air-shaft, and so creates up-currents through these channels. In order to take every advantage of the wind, and to avoid as much as possible counter-currents, chimneys and shafts should be carried up beyond the surrounding buildings. The aspiratory power of the wind may be greatly facilitated and insured by the use of cowls turning from the wind, and by other mechanical arrangements for preventing draughts and aiding up-currents.

#### Movements of Air Produced by Inequalities of Temperature.

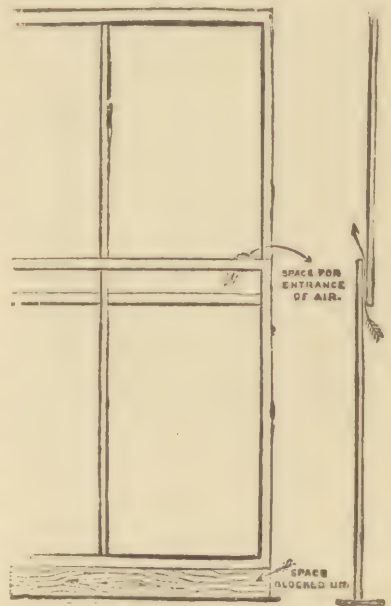
The differences of temperature between two bodies of air which are accessible to each other disturb the equilibrium and produce movements of the air. We are continually depending on this law in obtaining a change of air in our houses. The wind itself is caused by the disturbance of the equilibrium of the atmosphere produced by alterations of temperature. This power also operates in controlling the lesser movements of the air between the interior and exterior of our houses. Air increases or diminishes in bulk as it may be heated or cooled. Whenever it is heated it expands, and a portion of it escapes, and the colder air outside rushes in to take its place. In this way there is a constant interchange of air between the outside and inside, whenever any difference in temperature exists. By keeping the air inside the house warmer than that outside, and providing passages of entrance and escape for the air, a constant movement is kept up. The strength of this movement depends on the amount of difference in temperature between the outside and inside air.

### Window Ventilation.

Various arrangements have been proposed for utilizing the perflation of the wind. The windows of a room offer the simplest and most convenient means of securing this object. It has been advised, whenever possible, to have the windows on opposite sides of the room. These should be made to open at the top and bottom. If the top sash be lowered and the bottom sash raised, the warm air will pass out above and the cool air enter below. But in cold weather this cannot be done without producing an unpleasant draught; and, to obviate this, various arrangements have been adopted. One of the simplest of these plans is to raise the lower sash three or four inches and place underneath it a piece of board which will just fill up the space thus created. No appreciable amount of light is shut out by this plan, and it has the effect of affording a fresh-air inlet at the point where the lower and upper sashes join. As seen by Fig. 79, a current of air is admitted in an ascending direction, so that it does not usually create a draught. This plan is costless and of universal application, and is known to be exceedingly effective. Another plan is to bore holes through the lower bar of the upper sash, so as to admit the air in a vertical direction. The same object may be accomplished by placing a narrow board at the top of the upper sash and tilting it a little inward, so that the air, upon striking it, may be deflected toward the ceiling. Wire gauze is sometimes placed at the space to be left open, with the object of checking the velocity of the wind and preventing draught.

A very neat and useful form of window ventilation is described by Dr. Lincoln, of Boston. The lower sash is raised a few inches, and a double fibrous screen, which fits the window-frame tightly, is placed beneath it. These screens serve a double purpose; they retard the current of inflowing air, and at the same time deprive it, by filtration, of its coarser impurities. To give exit to the foul air, the upper sash is lowered a few inches, and a hinged screen is fitted into the space between the window-frame and the sash. If the wind out-of-doors is blowing toward that side of the room, the screen folds up automatically and excludes all unfiltered air. If the

FIG. 79.



"COSTLESS VENTILATION."

wind, however, blows from the opposite direction, the screen falls outward and allows the heated and foul air of the upper portion of the room to escape unhindered.

Another device, now much used, is what is called Maine's elbow-tube ventilator. This consists of two pieces of boards sliding upon each other,

FIG. 80.



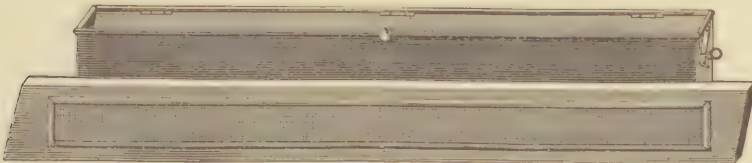
READ'S WINDOW VENTILATOR (inside view).

ings, about four or five inches in diameter, are made in this board, and to each one is fitted a metallic tube bent at right angles and provided with a valve to regulate the velocity of the current of air. The lower sash is raised to the requisite height and the board closely adjusted, with the projecting tubes on the inside. When in position, as shown by Fig. 13, the mouths of the tubes are directed toward the ceiling, against which the projected stream of air flows without causing draught.

Read's window ventilator is constructed upon precisely the same principle, the only modification being in the form of the inlet. It consists of a strip of walnut board with an opening in the centre, covered on the outside with a wire screen to keep out dust, insects, and so forth.

Through this opening air passes into a neat trough made of metal, and so arranged that the current of air passing through it shall be projected toward the ceiling. The trough is provided with a valve for regulating the quantity of air to be admitted. For

FIG. 81.



READ'S WINDOW VENTILATOR (outside view).

use it is simply required to raise the window and insert the apparatus between the sill and the bar of the lower sash. The inside and outside views of this ventilator, while in position, are represented by Figs. 80 and 81.

Perforation of one of the upper panes in the upper sash often serves a useful purpose. One plan is to remove the window-pane and insert in its



place a sort of funnel made of tin, and so arranged as to throw the current of air against the ceiling. Another plan is to insert glass louvres, or horizontal bars of glass, which are so inclined as to throw the air upward, the arrangement being similar to that of a Venetian blind.

Another plan of window ventilation consists of a metal plate attached to the lower bar of the lower sash, and parallel with it, with an opening in the lower bar for the admission of air. This plate works on a kind of hinge along its lower margin, and when in use tilts inward between side screens, so as to throw the air in an almost vertical direction. When not in use, the plate covers the opening and laps over it a slight distance. Another plan is to insert, in the place of a window-pane, a movable plate of glass, which is adjusted at will. Sometimes, when large quantities of air are required, the entire sash of a window is made to swing inward; but this is hardly ever necessary in private houses. Cooper's ventilator is sometimes used for windows. It consists of a movable disk of glass, with five holes in it, placed in front of a pane of glass containing five similar holes, and working on a central pivot. When the holes are opposite the air will, of course, come in. The air is not admitted in an upward direction, but this objection is counterbalanced by a provision for small streams of air, which are not likely to produce a draught. It need hardly be remarked, that the efficiency of all these devices may be impaired, if a proper arrangement of the window-shades, blinds, or curtains is neglected.

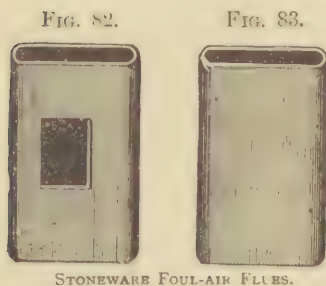
Where Venetian blinds or inside slatted shutters are used, it is only necessary to lower the upper sash, and arrange the slats or louvres in a direction slanting toward the ceiling, in order to give the entering air an upward course.

Double windows have advantages, especially in the cold season. It may have been observed, in sitting close to a window in cold weather, that cold air comes from the window even when tight, giving the impression of a draught. This is caused by the rapid cooling of the air of the room in contact with the window-panes, and its movement toward the floor by displacement. This may be obviated, if deemed advisable, and a great deal of heat saved, by making the windows double. But this arrangement is also useful for the purposes of ventilation. By raising the lower sash of the outer window and lowering the upper sash of the inner window, the air will enter below, and, passing upward between the two windows, will escape into the room near the ceiling, after having been warmed considerably by coming in contact with the glass of the inner window.

As a temporary expedient, useful on some occasions, as, for example, at evening receptions, the lower sash may be raised and a sheet of calico or muslin suspended as a valve in front of the opening. The sheet is attached to the sides of the frame and to the sill, while the upper edge hangs free and slopes into the room. Firmness may be given to it by the use of

stout wire. The effect is to throw the air up toward and along the ceiling without causing draughts, so much complained of and so dangerous when the windows are hoisted or lowered in the ordinary way.

In all these cases an outlet must be provided for the vitiated air of the



STONEWARE FOUL-AIR FLUES.

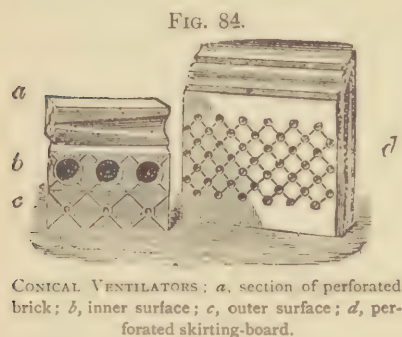
room, and this is usually accomplished by means of the chimney-flue. Stoneware foul-air flues (Figs. 82 and 83), placed alongside the chimney, are by all means to be preferred. Their smooth interior surface facilitates the upward current of air, and, in case of a downward current, no annoyance is created by a reflux of smut-laden air. The outlets should be placed near the ceiling, and when the chimney is used, should, by all means, be

provided with a valve to prevent the influx of smoke, as reversed currents will occasionally take place.

#### Special Openings for the Admission of Fresh Air.

The perflating power of the wind may be utilized by providing special apertures in the walls or doors. A great variety of contrivances have been designed for regulating the admission of air in this way, so as to obviate the unpleasant effect of draughts. Perforated or air bricks are sometimes placed in the external wall, but unless guarded on the room side by some kind of a movable deflector, or valve, they are apt to give

trouble by causing draughts. Fig. 84, *a, b, c*, represents several views of a perforated brick designed by Ellison, which is peculiar in respect to the conical form of the holes. The object of these trumpet-shaped openings is to distribute the air so that no draught shall be felt. The plan of admitting air close to the floor by means of perforations in the skirting-board has been proposed, and several ingenious designs have been made for distributing the air thus



CONICAL VENTILATORS: *a*, section of perforated brick; *b*, inner surface; *c*, outer surface; *d*, perforated skirting-board.

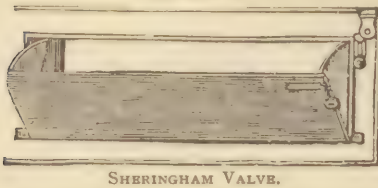
admitted without producing a draught. One of these is shown in Fig. 84. *d*. If these devices were applied to the cornices of a room, they would answer the purpose admirably, but it is not advisable to admit air at the level of the floor, unless it is first warmed.

The simplest way of introducing air from without is to make an opening in the wall towards the upper part of the room, and fix a board in front of it in a slanting direction, so as to direct the air toward the ceiling. This board is attached by its sides to the wall by some flexible material to

give it support and regulate its slope, and to prevent the air from escaping at its sides in a downward direction. Small openings are to be preferred to large ones, and where a large quantity of air is required, the number should be increased. It is a difficult matter to fix the proper size of the opening, as the conditions in natural ventilation are not constant. It has, however, been calculated that an opening equal to twenty-four square inches of area is, under ordinary conditions, sufficient for one person. Inlets similar to that just described are sometimes placed in the upper part of a door, by removing a panel; or a transom may be constructed over the door. The air supplied by this means is not likely to be pure, and this is the great objection to this form of ventilation.

The Sheringham valve (Fig. 85) has been before the public for a great while, and is not without merit. It is usually fitted to the outer wall, through which the air is admitted

FIG. 85.



SHERINGHAM VALVE.

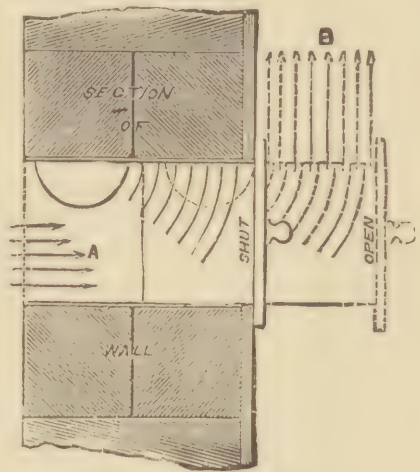
by a perforated brick or iron grating. It consists of a metal box placed in the wall, with a metal flap, or valve, which can swing forwards, and is balanced by a weight at the end of a

string moving over a pulley. By means of this cord, the valve may be opened or closed or kept in any intermediate position. These valves are usually placed near the upper part of the room, and their design is such that the entering current of air is always directed toward the ceiling. Rooms having two outside walls can be provided on both sides with valves of this description, one set acting as inlets, the other as outlets; by this means, the movement of air may be kept up continuously.

Dr. Corfield mentions a device, somewhat different, but having the same object in view. It is Stevens's drawer ventilator, which is very much like a drawer and is made to fit into an opening in the wall, protected on the outside by a perforated brick or iron grating, and arranged to pull out a certain distance to allow the air to pass almost vertically into the room between plates of metal placed within it (Fig. 86).

Another plan for admitting fresh air into rooms is by means of vertical tubes carried for a distance up the walls, a method which has been revived

FIG. 86.

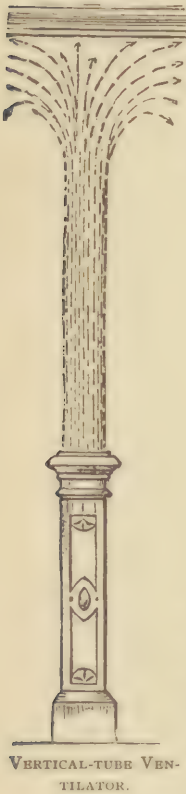


STEVEN'S DRAWER-VENTILATOR.



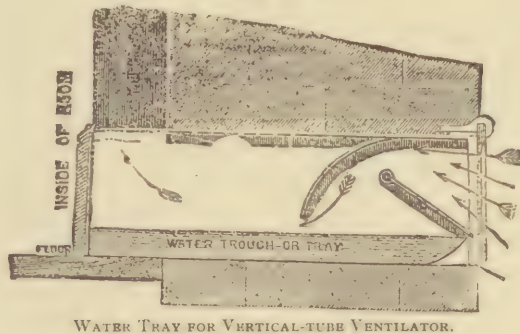
by Mr. Tobin, of Leeds (Fig. 87). The air is introduced from the outside at the level of the floor, and then, by means of a vertical pipe about five or six feet in height, is delivered to the room in a vertical direction, which is retained for some distance before it begins to spread out like a fountain and descend. When properly arranged, there is no rebound of air from the ceiling. The action of the tube is modified by the direction of the wind, and cannot always be depended on; but, notwithstanding this objection, the method is an exceedingly useful one in cases where there is difficulty in introducing air by other means. It is often the case that the

FIG. 87.



air is filled with dust and soot, and when admitted to a room in the manner just described, carries these impurities along with it. To obviate this difficulty, the opening may be covered with gauze or thin porous flannel, but this impedes the current of air. A better plan is that of washing the air before it issues into the room. The accompanying cut (Fig. 88) of a patented

FIG. 88.



device illustrates the method. It consists of a tray containing water, which is placed in the opening in the wall between the inlet and the mouth of the tube. The dust-laden air, after entering, is deflected by means of metal plates on to the surface of the water, and is quite thoroughly washed before it passes into the tube. The water will, of course, require to be occasionally changed.

Dr. Corfield, in his description of this plan, suggests that in summer time ice may be placed in the tray to cool the air.

A hollow perforated cornice has been proposed as a very satisfactory means of ventilation for a large room. This is made of metal, and is divided longitudinally into two channels. Air enters the lower one from an opening through the wall at one end, and is delivered to the room by small perforations. The upper channel is connected with the chimney-flue or an air-shaft, and receives the vitiated air through a number of small perforations, and carries it away. The fresh air, being colder, falls

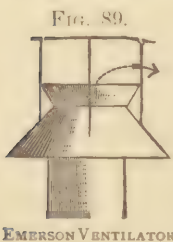
into the room, while the respired air, being warmer, rises toward the channel of escape.

### Special Openings for the Removal of Vitiated Air.

For the escape of foul air, the chimney-flue is most generally made use of. It is the simplest plan, as no house is without a chimney. Special air-shafts are sometimes constructed for the extraction of vitiated air. Their satisfactory action requires the application of heat. When placed alongside the smoke-flue, the heat of the chimney can be utilized in assisting the ascending current of air. A smooth interior surface, such as is afforded by a stoneware lining, or a casing of heavy tin, will lessen the friction and aid the upward current of air. The aspirating power of the wind is made use of to produce upward currents in ventilating-shafts. The irregularity and uncertainty of its action form the main objections to it. The wind may impede the escape of air by its pressure, or by blowing down the chimney or tube. To overcome this difficulty, a vast number of devices have been made for obtaining the full aspirating power of the wind, and also for preventing down-draughts and the entrance of rain.

### Contrivances for Utilizing the Aspirating Power of the Wind.

These devices, commonly known as "cowls," have been produced in endless variety. Some of these cowls are fixed; others are made to revolve with the wind. Movable cowls are made to rotate according to the direction of the wind, by means of vanes, so that the opening is always turned away from the wind. The outlet should gradually increase in size to the outer rim, the diameter of which should greatly exceed that of the tube. All cowls should be nicely balanced, and so adjusted that they can rotate by the slightest impulse of the wind. In this requirement



EMERSON VENTILATOR

there lies a strong objection. It is well known that all kinds of apparatus with moving parts, when exposed to the weather and seldom inspected, are liable to get out of order and remain so. Under these circumstances they are worse than useless. Fixed cowls have not this disadvantage, and certainly are of use in preventing down-draughts and the entrance of rain,

and, to some extent, in increasing the up-draught, though upon this latter point there is a very great difference of opinion.

According to Dr. Billings, one of the best of all the various forms of fixed cowls is what is generally known as the Emerson ventilator (Fig. 89). A committee appointed by the American Academy of Arts to determine, by experiment, the effects of various forms of outlet-cowls, designated as the best form of cowl, the one illustrated by Fig. 90. Dr.



USEFUL FORM OF COWL.

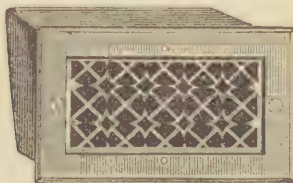
Billings prefers this form of cowl for all up-cast shafts. Mr. Hellyer, who has carefully investigated the subject, concludes that the best cowls are better than open pipes, and he is probably correct in this view.

Louvred openings are sometimes used for utilizing the aspirating power of the wind, but they are hardly so satisfactory as cowls, as they are apt to permit down-draughts and let in the rain.

### Position and Description of Outlet-tubes.

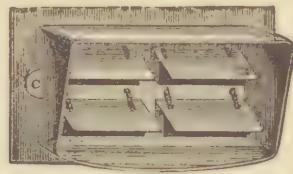
Openings for the escape of impure air are generally made in the upper part of the room, near the ceiling. If the chimney is used,—which is the most convenient plan but not always the best,—the opening must be protected by a valve to prevent the entrance of smoke and soot caused by a down-drawn draught. Valves constructed on the principle of the Arnott valve are commonly used for this purpose. It consists of a light flap of metal, carefully adjusted in a frame-work inserted in the wall, and so designed that it can open into the chimney-flue by the slightest pressure of air from the room, and close with equal facility by gentle pressure from the other direction. Cloth valves are sometimes used, and are said to be silent in their action and satisfactory. A neat and serviceable form is the mica-flap valve (Figs. 91 and 92). Flaps of

FIG. 91.



MICA-FLAP VALVE (outside view).

FIG. 92.



MICA-FLAP VALVE (inside view).

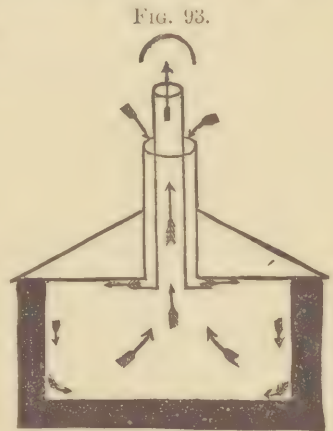
mica are hung with wire, and so delicately adjusted that a very gentle pressure will swing them inward and allow the air to escape from the room into the flue, while any pressure the other way will close them. The plates of mica are very thin and light, yet sufficiently firm to resist the pressure of air from the chimney. These valves should act promptly and silently, and, as they are of delicate construction, require to be looked after occasionally, in order to see that they are operative.

It is not a wise plan to use the chimney as a ventilating flue, if other means of escape for the foul air can be provided. Smoke and soot are sometimes driven into the room in spite of the valves, especially should they become obstructed. It is much better to provide special channels for the escape of foul air, the current of which can be accelerated and made constant by heat specially provided, or borrowed from an adjoining smoke-flue. Air-flues and smoke-flues are now moulded in the same piece of fire-clay. By this combination the heat of the chimney is util-



ized in warming the air in the neighboring flue, and in causing an active upward movement. The heat of the kitchen or furnace-flues, or of any other smoke-flue, can be used in this way with manifest advantage. Outlets to air-shafts are usually provided with registers, or gratings, arranged with valves. To obtain the full aspirating power of the air-tube, allowance should be made for the obstruction offered by the grating, and a large size should be chosen.

Inlet- and outlet-tubes are sometimes combined in the same ventilator, and are intended to be inserted in the centre of the ceiling of a room or space to be ventilated. They are best adapted to rooms having no story above them, though they have been used under other circumstances. When a single tube is carried from the ceiling of the room beyond the roof, the current of air passing through this channel will be observed to be very variable and irregular. The outer air will descend and the inner air will ascend, and the currents counteract one another with the effect, sometimes, of arresting movement altogether. Now, if this tube be divided longitudinally, its action becomes changed; an in-current being set up in one-half the tube, and an out-current in the other. This circumstance has been taken advantage of in planning double-tube ventilators, the best of which is probably the one known as McKinnell's (Fig. 93). "It consists of two hollow cylinders, one within the other, and of such relative calibre that the transverse area between the tubes is equal to the area of the inner tube. The inner tube is of slightly higher elevation than the outer, and acts as the outlet. The fresh air enters between the tubes, and is thrown toward the ceiling by means of a horizontal flange surrounding the lower margin of the inner tube." Both tubes should be provided with valves. If there is an open fire-place in the room, both tubes may become inlets; and if the windows and doors are opened, both tubes may become outlets. These points must be borne in mind in regulating the action of this form of ventilator. If a gas-burner be placed under the central or outlet-tube, the escape of air by this channel will be very much increased. This is the principle upon which lights are often arranged in railway cars. The tubes, being carried to the external air, will require a cover of some kind to keep out the rain.



McKINNELL'S VENTILATOR.

#### Artificial Ventilation and Heating.

These two subjects being closely related will be considered together. There are two methods of accomplishing artificial ventilation: one in

which the air is drawn out of a room or building (extraction or aspiration); the other, in which the air is forced into or through a room (propulsion). These methods are sometimes called the *vacuum* and *plenum* systems of ventilation.

#### Ventilation by Extraction (by the Agency of Heat).

The method by extraction, so far as it relates to the means of obtaining ventilation by the application of artificial heat, shall chiefly engage our attention, since it is the plan best adapted for use in dwelling-houses. For many months in the year the air may be allowed to sweep freely through the house; but in the season when windows and doors are closed, artificial heat becomes a very necessary and important factor in the distribution of the air of a dwelling.

One of the best known examples of ventilation by extraction, or aspiration, is that furnished by the common chimney. The chimney-flue acts as a very efficient ventilating-shaft, even when there is no fire; but, by placing a gas-jet in it, or by the use of a fire, its action may be greatly increased and rendered more or less constant. The up-current will be in proportion to the size of the fire and of the chimney. It is estimated that a fire in an ordinary open fire-place will extract between 6,000 and 20,000 cubic feet per hour, and not only will it reverse the action of all other outlets, but it will often draw air from a long distance, unless a supply of air is provided near at hand.

If the room is not provided with sufficient inlets, a current of air is established down the chimney to feed the fire, and this is one of the causes of smoky chimneys. When this occurs, proper inlets should at once be created.

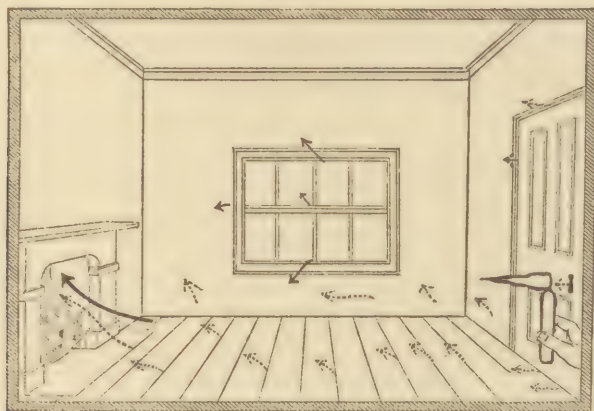
As has already been remarked, the chimney-flue, when warmed by a fire, can be utilized as an outlet for impure air; but, when possible, it is best to make use of air-shafts at the side of or surrounding the flue, into which openings can be made for extracting the air.

#### The Open Fire-place a Powerful Ventilating Agent.

The open fire-place forms a simple and most efficient outlet for ventilation; in fact, if proper inlets are provided, no other form of outlet is required in dwelling houses. The open fire extracts the air from a room with great rapidity, and causes an active circulation of air. The heat is obtained by radiation from the glowing coals, and by radiation and reflection from the different parts of the grate. The air in the room is warmed by the fire first warming the walls, ceiling, floor, and articles in the room, and these, again, warm the air. The heating is similar to that by the rays of the sun; the bodies which intercept the rays of radiant heat become warm, and these bodies warm the air.

The amount of air discharged by an ordinary fire-place is very great, and the quantity of heat wasted under usual circumstances is also enormous. Upon the authority of Galton it may be stated, that, at a very low computation, the air will pass up an ordinary chimney-flue at the rate of from four to six feet per second, or from 14,000 to 20,000 cubic feet per hour. In a large room, having a cubic space of 4,800 feet, the air would be removed four or five times in the hour, with a good fire in the grate; with a blazing fire, the air would be changed from six to eight times in the hour. It is therefore safe to conclude that a single chimney, with an ordinary fire, will act as an efficient ventilating-shaft for a room containing four or five persons. When the rooms are large and are occupied by a greater number of persons, other outlets are necessary. This means of heating a room tends to create draughts, as the chimney has a powerful aspirating force, and will draw air into the room from all directions to meet its wants. Owing to this circumstance, discomfort may be occasioned in cold weather, unless the fresh air admitted is first moderately

FIG. 94.



FIRE-PLACE, WITHOUT SPECIAL INLETS FOR FRESH, WARMED AIR—THE RESULT, DRAUGHTS.

warmed. Figure 94, from Teale's *Dangers to Health* shows how an open fire-place, without provision for the admission of fresh, warmed air, will draw a supply from various irregular sources: from the chinks in the window, represented by black arrows; and through the keyhole, skirting-boards, floor-boards, and walls, as represented by the dotted arrows.

"The way in which an ordinary open fire-place acts to create circulation of air in a room with closed doors and windows is as follows: The air is drawn along the floor toward the grate; it is then warmed by the heat which pervades all objects near the fire, and part is carried up the chimney with the smoke, whilst the remainder, partly in consequence of the warmth it has acquired from the fire and partly owing to the impetus created in its movement toward the fire, flows upward toward the ceiling near the



chimney-breast. It passes along the ceiling, and as it cools in its progress toward the opposite wall, descends to the floor, to be again drawn toward the fire. It follows from this, that, with an open fire-place in a room, the best position in which to deliver the fresh air required to take the place of that which has passed up the chimney, is above the projecting chimney-piece, and at any convenient point in the chimney-breast between the chimney-piece and the top of the room, for the air thus falls into the warmer upward current and mixes with the air of the room without perceptible disturbance. The open fire-place thus presents special advantages for securing efficient ventilation by means of the circulation of air which it creates. It makes the room in which it is in use independent of other means of extraction of air, unless the room is very crowded, or beyond the size for which the fire-place is calculated."

An enormous amount of air is discharged by an ordinary fire-place, and at the same time an enormous quantity of heat is wasted. To avoid uncomfortable draughts, fresh, warmed air should always be provided in the place of the air passing up the chimney; and to economize fuel, structural arrangements specially designed to effect this object should be made use of. By attention to these two important particulars, a most efficient and entirely satisfactory system of artificial ventilation and warming can be provided by means of the "open grate." In old houses, it is not always practicable to adapt the existing arrangements to these requirements; but a great improvement may often be effected, by reconstruction according to well-established principles. The shape of the fire-place should be such as to afford the full benefit of the rays of heat. The sides and back should be splayed, or sloped, so that the rays of heat can impinge the more readily on the walls and floor. The old-fashioned square fire-place, with high chimney-breast and large chimney, is wasteful of heat and unproductive of comfort, because the principle of construction is wrong. The materials of which the fire-place is constructed should assist in warming the air. To accomplish this purpose, they should be non-conducting and have a surface which readily absorbs and emits heat. Enamelled tiles are sometimes used for the sides and back of a fire-place, and with manifest advantage, as the glazed surface emits the heat more freely than iron or brick. The size of the fire-place should be adapted to the size of the room, and the area of the chimney should bear a proper proportion to the size of the fire and to the quantity of air supplied to the room. The size of the grate should also be adapted to the room, and the form should be such as will secure an abundance of radiant heat with the least amount of smoke, and with economy of fuel. Fire-brick is a good lining for a grate, as it conducts heat slowly and radiates it freely into the room.

When two or more fire-places are used in a room, they should be placed on the same side of the room; and if ventilating-shafts are used in addi-

tion, they too should be placed on the same side of the room as the fire-place, but as far as possible from it. If it can be avoided, a fire-place should not be placed in the external wall, as a large amount of heat is wasted in this way.

#### **The Use of the Open Fire-place in Cold Climates.**

While the open fire-place is a most efficient ventilator, and a comfortable and cheerful means of warming, it cannot be depended on as the main source of heat during the winters of our northern climate. In the spring and fall seasons of such a climate, and in the mild winters of the South, when only a small amount of heat is required, it answers the purpose most satisfactorily. But in those places where the cold is intense and prolonged, some other more certain means of heating must be adopted, and the open fire-place must be considered as merely supplementary to the furnace or stove as a source of heat. When other fires have to be maintained, the expensiveness and troublesomeness of this means of heating become serious objections to it; but its advantages in removing vitiated air from an occupied room are so great that it is advised, notwithstanding these objections, that every inhabited room in a dwelling-house be provided with an open fire-place, as a means of ventilation, if for no other purpose.

#### **Disadvantages of the Ordinary Open Fire-place.**

The disadvantages of the ordinary fire-place as a means of heating have long been recognized, and inventors have been busy in endeavoring to overcome them, and thereby extend the scope of usefulness and popularity of this important contrivance. In order to prevent excessive draughts, which often set toward the fire from the windows and doors to replace air which has been warmed and withdrawn up the chimney, it is customary to lead the air from the exterior of the house by special ducts which terminate in a grating in the hearth. The air thus entering at the grate is partially warmed, a portion being drawn up the chimney and the remainder of it mingling with the air circulating in the room. The result is the avoidance of objectionable draughts, and a more comfortable condition of the atmosphere of the room. But comfort is secured at the expense of ventilation, since by this plan the fire ceases to withdraw the air from the room, and, therefore, to ventilate the apartment, in proportion to the amount of air supplied to it from this special source.

#### **Advantages of the Ventilating Fire-place.**

A great step in advance was made when the so-called open ventilating-grates were devised. The essential feature of this arrangement consists

in the use of a chamber behind or around the fire, at the foot of the chimney, into which fresh air from the outside is led to be warmed and then passed into the room by openings above the mantle-piece, or the cornice, or on either side of the fire. With a grate of this description, heat is utilized, the temperature all over the room is made remarkably uniform and comfortable, draughts are rendered next to impossible, and a proper ventilation is secured. Moreover, any excess of heat may be made use of for warming adjoining rooms or upper stories, by leading tubes from the air-chamber to these places, the discharge of heated air being regulated by the use of valves.

Of the numerous grates constructed after this system, that of Captain Galton has been very highly commended, and may be taken as an example of the class. Fig. 95 represents a sectional view of one of these

FIG. 95.



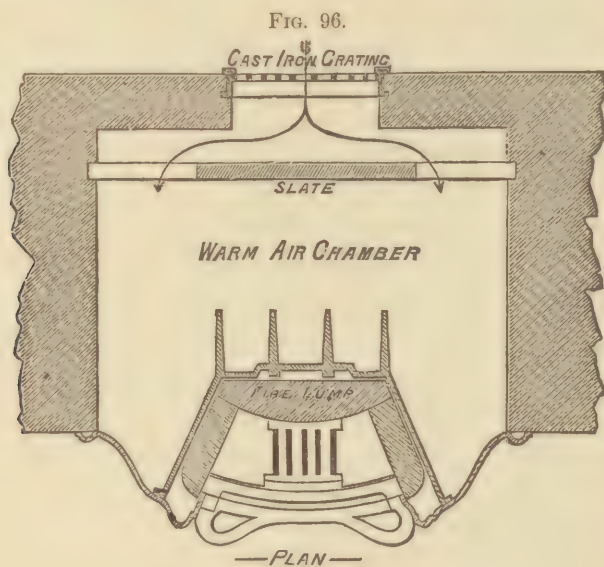
GALTON'S GRATE, SHOWING ALSO THE CURRENTS OF AIR IN A ROOM.

grates, and also shows the currents of air in the room. It is seen how the outer air is admitted at the back of the grate, where it is warmed by a large heating-surface, and then carried by a flue alongside the chimney-flue to an opening near the ceiling, whence it issues to mingle with the air circulating in the room. The grate itself is specially constructed to give off the largest amount of reflected heat, and to diminish the amount of smoke by securing a more perfect combustion of the gases. This fire-place is said to produce the same degree of warmth in the air of a room with only one-third the quantity of coal required by an ordinary fire-place; and it has the additional advantage of supplying a large amount of fresh air, moderately warmed, and of preserving an equable temper-



ature all over the room. A horizontal section of this grate is seen in Fig. 96. The air supplied to the chamber is admitted from the outside through perforated bricks or gratings in the external wall, and conducted through a channel beneath the floor or behind the skirting.

Grates constructed on the principle of warming fresh air by means of a chamber behind the fire are made of different designs and sizes; some of them being specially constructed for use in old houses, where it would be troublesome or inconvenient to cut into the chimney-breast. Griffin's grate, also an English pattern, is one of this kind, and it is said to be economical to fix and capable of maintaining a very even temperature in the room. "Fire on the hearth," an American grate, belongs to this class, and is very popular.

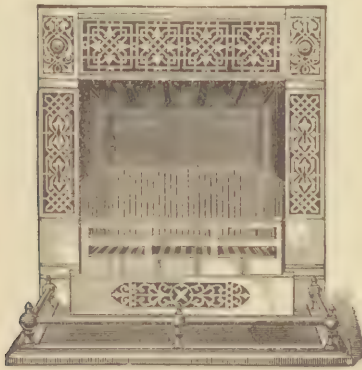


GALTON'S GRATE IN HORIZONTAL SECTION.

Similar in design to the Galton grate is the Jackson grate, also an American invention, which is illustrated by Figs. 97 and 98. The construction of this grate is represented in Fig. 98, the outer shell being partly broken away for the purpose. Fresh air is brought from out of doors by means of a duct beneath the floor, and is admitted through an opening shown in the base of the cut. After circulating between the inner and outer shells, it passes between the smoke-flues, and thence through the open-work frieze (shown at the top of the cut, Fig. 97) into the room. This form of construction does not require the tearing away of the chimney-breast for inserting a hot-air flue, and therefore is well adapted to houses already built. In new houses, and in cases where the expense of cutting out the wall is not objected to, a flue may be constructed to deliver the heated air near the ceiling of the room, or even to the room above.

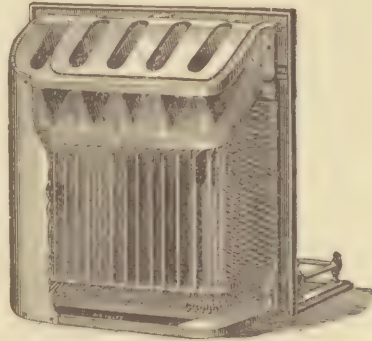
Mr. Snell has invented what he calls the therm-hydric grate (Fig. 99), which is designed upon the principles above set forth, but with a modi-

FIG. 97.



VENTILATING-GRATE (front view).

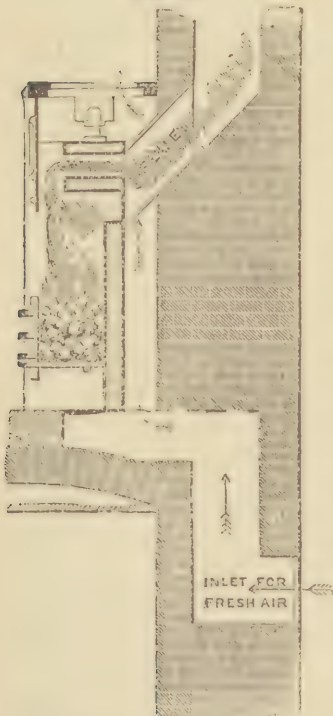
FIG. 98.



VENTILATING-GRATE (showing construction).

fication in the means of heating which he considers an improvement on the usual plan. A small boiler is placed behind the grate, which communicates with coils of iron pipes placed alongside of it. These are filled with water, which becomes heated and imparts warmth to the fresh air which circulates about them before being admitted to the room. Equability of temperature and mildness of heat are advantages claimed for this system; but, while the general plan is a good one, it is doubtful whether it has any appreciable advantages over the less expensive and less troublesome plans already alluded to.

FIG. 99.



SECTION OF THE THERM-HYDRIC GRATE.

The open ventilating-grate is destined to supplant the ordinary grate, which is enormously expensive and otherwise unsatisfactory. As a cheerful and agreeable means of warming that can be relied on in moderately cold weather, or that may be used to supplement the heat of the furnace or stove in the very cold season, and as an efficient and reliable means of ventilation, it recommends itself to popular favor, and should form a part of the structural arrangements of every dwelling.

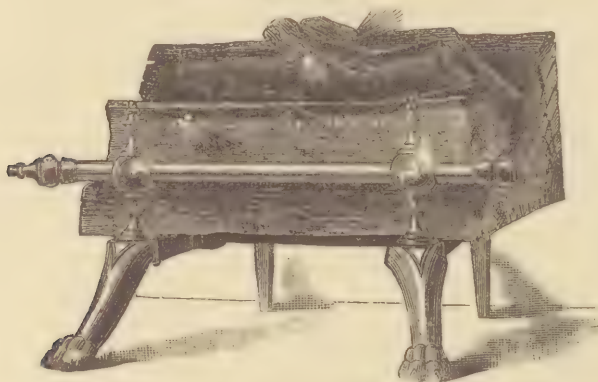
In the larger houses, the furnace in the basement, with pipes distributing warmed air to the different apartments, is preferred on account of convenience, cleanliness, and the saving of labor; and, combined with the open

fire-place, it does form a very satisfactory means of heating and ventilation. In smaller houses, the closed stove is preferred on account of its more ample heating power and greater economy of fuel. Ventilating-flues and open fire-places are not regarded with favor, as they are looked upon as so many channels for the waste of heat. Consequently, the demand for the improved grate has not at any time been very pressing. Nevertheless, a number of these grates of American design have been produced, and can be obtained without difficulty.

### Open Gas-fires.

Open gas-fires are sometimes burned in grates in places where it is inconvenient or dangerous to burn coal, or where a fire is only occasionally required. The arrangement for burning gas in this way is called a "gas-log," a contrivance made of fire-clay in imitation of logs of wood (Fig. 100). The log is partly hollow, and is perforated with numerous small

FIG. 100.



GAS-LOG AND ANDIRONS.

orifices, through which the gas escapes and envelops it in flame. To give cheerfulness to the fire, lumps of pulled fire-clay and fleecy pieces of asbestos are attached to the surface of the log. These become incandescent when exposed in the flame, and give a brilliant and pleasing effect to the fire. The supply of gas may be obtained by fitting up a service-pipe underneath the grate, or by using a rubber tube connected at one end with a nipple in the floor at the side of the fire-place, and attached at the other end to a similar mouth-piece underneath the log. Gas-logs may be placed in an ordinary grate, or upon andirons set in a common fire-place (Fig. 100). With this arrangement, a very considerable amount of heat is produced. The device is useful for ventilation, is instantly available, can be quickly dispensed with, makes no dust, requires little or no care, and is serviceable at times in supplementing the heat derived from other sources.



### Heating by Stoves.

Another method of heating, and that by far the most commonly adopted, is by means of stoves. With this kind of apparatus, the fuel is burned in a close chamber, in distinction from an open grate, and the air of the room is warmed by coming in contact with the heated surface, and, to some extent, by radiation. Stoves may be used in the room to be warmed, or they may be placed in a specially constructed chamber, where the air is heated, and then distributed by means of flues to the places where wanted. This latter plan—furnace-heating—is the one so extensively used for warming large houses.

A stove gives out, ultimately, all the heat which the fuel develops, except, of course, that which passes up the chimney with the other products of combustion. It is, therefore, an economical means of heating. From this point of view, the value of a stove will depend upon the amount of heat that can be utilized. When located in the space intended to be warmed, the full effect of the heat is realized. If placed in an air-chamber, as in furnace-heating, much of the heat is abstracted by the flues which conduct the warmed air over the house. If the flues are very long, and are constructed in an exposed position, as in an external wall, or are composed of materials which are good conductors of heat, a great quantity of the heat passing through them will be wasted. Under certain circumstances, this loss is retrieved, as, for example, when the flues are built in the inside walls of a house; or, better yet, when they are grouped in the centre of a house, the heat which they absorb will eventually be given out to the house. The location of the chimney-flue in this manner is advised as an aid in warming the house, as the heat will be given out from the lining which becomes warmed by the passage of smoke.

### Radiant and Convected Heat.

The principal ways in which heat is communicated to the air of a room and its contents are by radiation and convection. Under this latter term is included conduction, by which is meant the passage of heat from one particle to another. Radiant heat, such as is imparted by an open fire, warms the walls, ceilings, and objects in a room, and these become reservoirs of heat, and impart warmth to the air, mainly by convection; but it does not sensibly warm the air while passing through it. To satisfactorily warm an apartment and make it safe for occupancy, the walls and solid objects should be heated to a temperature required for the air of the room. The air of a room may be quickly heated by a stove to a comfortable temperature; but, unless the walls are also well heated, it is not safe to remain in it, especially if the walls are damp as well as cold. A stove warms, to some extent, by radiation; particularly, if the body be

raised to a high degree of temperature. But it is mainly by convection that the heat is communicated. The heat of the fire first warms the surface of the materials which enclose and come in contact with the burning coals and gases, and then passes through them to the outer surface, which is in contact with the air; and the air is then heated by contact with this outer surface.

### The Mode of Action of a Close Stove.

Mr. Briggs thus describes the mode of action of a close stove: "Surrounding any stove in active operation there exists an envelope of air, gradually ascending, as it acquires heat, toward the ceiling. In what way does this envelope come to have any considerable thickness? Air is nearly a perfect non-conductor of heat; one particle of air does not, or at least, very slowly, receive heat from another particle. As before stated, air permits the transmission of radiant heat without absorbing it. Only the thinnest film of air can possibly be in contact with the surface of the stove at any instant of time; and yet it is only by contact that the air is heated. In fact, the air does not, nor does any fluid, whether gaseous or liquid, slide upon a surface along which it passes. The movement is a rolling one. D'Arcey describes the movement of water in a pipe to be similar (but reversed) to the stripping of a glove from the finger by turning the glove-finger inside out. In a similar rolling movement, the sheet of air passing the stove comes to have a definite thickness, and involves in its rolling process particles of air remote from the ascending stream.

"As a stone thrown into a pool transmits its vibrations over the surface, so any disturbance of a fluid body confined in an inclosure is transmitted and communicated throughout the fluid to its most distant part, with some relative intensity. There rises from the stove a current of air of considerable volume, acquiring, as it ascends, a nearly uniform temperature, but with a nucleus hotter than the general temperature of the room. This heated air endeavors to find its level next the ceiling, but to do so, it must not be assumed to slide in under the warm air which it finds in contact with the ceiling. Instead of this, the interposition will be accomplished by a rolling action similar to that on the stove-surface, wherein one set of particles rolls off, and the other rolls upon, the ceiling, with mutual admixture and equalization of temperature in the process.

"With the accumulating of a stratum of air next the ceiling, a corresponding absorption from the floor-stratum must have occurred. The necessity for the stove at all is the presumption that some loss of heat must have been going on at the windows and walls equivalent to the heat imparted by the stove.

"The windows and the walls impart 'cold' in the same way and after the same laws of convection as the stove imparts heat. In one part of the

room the stove will have been forming an ascending current of considerable intensity or velocity all around itself, while at another part the windows and cool walls will have a sheet of cool air, of less velocity, but of equal heat-value, traversing them downward.

"The most uniform distribution will be effected when these currents become the most general, extensive, and, consequently, most moderate. Suppose the stove to have its position remote from the windows and cooling walls, and to be so placed that the average extent of window or wall-surface or exposure shall be equi-distant from the stove; it can then be asserted that the column of hot air from the stove will, after rising, roll upon the ceiling and become intimately mixed and equalized in temperature with the air it finds there; and that the sheet of descending air from the windows and walls will roll out upon the floor and intermix with the air on that level, establishing an equality of temperature in that stratum. Within certain well-known limits of size or shape of room, and with a close room, the lower six, or eight, or ten feet of height of the room will be heated by a stove, in any weather, so that the differences of temperature within that height shall not affect the comfort of the occupant.

"When the stove is so small as to demand inordinate heating of its surface to impart the required quantity of heat, successful warming is secured by protecting the occupants from direct radiation by screens of inclosing envelopes, which are found to accelerate the rising current of hot air; and this is done without very materially impairing the distribution of heat; and even when the sashes are not very tight in the window-frames, tolerable uniformity of ground-temperature is reached."

#### **The Advantages and Disadvantages of Heating by Stoves.**

Against the mode of heating by stoves, which is very commonly adopted in this country on account of its convenience and great economy, there exists a strong prejudice in the minds of some people. Says Mr. Leeds: "Convected heat is the great curse of the American people. It is dry, lifeless, withering, debilitating, poisoned stuff, with which most of our best houses and public buildings, and, most unfortunately, many of our school-houses, too, are filled and warmed; and which is filling our systems, and warming and drying the life and substance out of about two-thirds of the people of this country." This opinion applies to the use of the system, or, more properly, the abuse of the system, as commonly met with. But there is no reason why this system, combined with proper ventilation, should not be available for acquiring an agreeable and healthful quality of heat, provided, the proper kind of apparatus be used, and care be exercised in not unduly raising the temperature of its heating-surface. It is known to be a fact, that air heated by contact



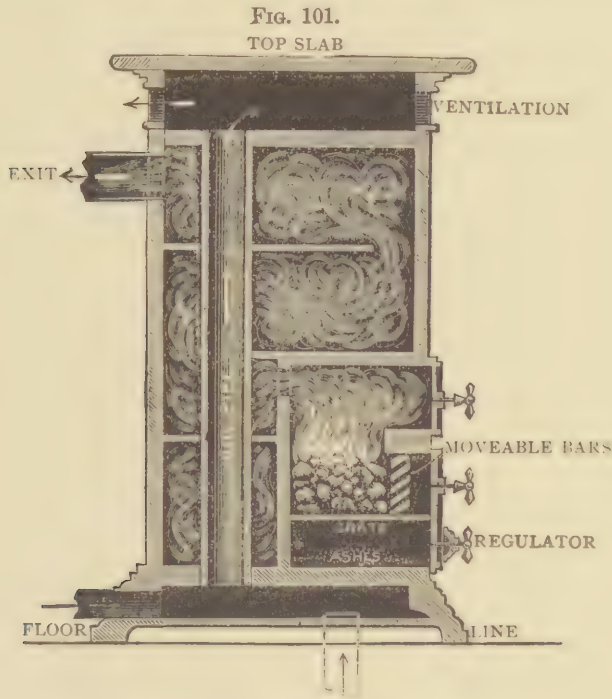
with *moderately* warmed surfaces has an extremely pleasant quality. The Russian or German stove is an example at point. These stoves are generally built of brick or porcelain, and are of large size. On account of the slow conducting power of the material, and the great thickness of the walls, they are slowly heated and slowly cooled. Consequently, the air is heated more equably, and with pleasant effect. The main object of these stoves is to economize heat, and this is secured by passing the smoke and heated gases from the fire up and down the structure through flues, before reaching the chimney. A brisk fire is made in the stove, and when the wood is well burned up, the door in the fire-box is closed and the dampers shut, so as to prevent any escape of heat up the chimney; the heat is thus retained in the body of the stove for a very long time. But the great objection to this stove, as usually managed, is that it does not assist in ventilating the room. On the contrary, by closing the damper, the gases from the partly-consumed fuel are apt to escape into the room, and fatal cases of poisoning from this cause have not been of unfrequent occurrence in Germany. It is an economical contrivance, especially when all avenues of entrance of fresh air are occluded, as is too frequently the habit in that country; but the saving of fuel is at the expense of health.

An improvement in this stove is a form designed to warm fresh air admitted from outside, which has been applied by Dr. Böhm in heating the Rudolf Hospital at Vienna. The stoves are of large size, and are placed in the ward. The fresh air is warmed in its passage through a flue in the stove, and passes out at the top, and is made to circulate toward the floor, thus bringing into action the principle of the open fire-place.

A form of German stove designed to warm fresh air has been produced by the Messrs. Doulton, of England, which is said to be a very agreeable and convenient means of warming. A section of this stove is shown in Fig. 101. These modifications nullify the economic feature of the German stove, because the heat must be constantly maintained to warm a stream of fresh air constantly admitted; and, as a further disadvantage in heating economically, the material of the stove is a bad conductor of heat. The loss is, however, counterbalanced by the advantages which inure to health.

In this country, most dwellings are heated by stoves as the method affording the greatest economy of fuel and saving of labor. The hot-air furnace is also extensively used, and probably ranks next in point of economy. Steam-heating and hot-water heating is mostly confined to public buildings. The fire-place with open grate is growing in popular favor; but as it is necessary to supplement it, except in mild weather, with some other method of heating, it becomes an expensive method in this climate, and is not likely to be generally adopted, although its sanitary advantages are of marked value.

The stove being the kind of apparatus most commonly adopted, there has naturally arisen a most active competition for trade, and numerous different patterns have been placed upon the market. With regard to the relative merits of these various forms, there appears to be very little information that is trustworthy. The records of experiments made by stove-makers can hardly be depended on, as the tests are made from an interested stand-point; beyond these there are but few records that are available. Says Dr. Billings: "So far as economy of fuel and labor is concerned, when anthracite coal is to be used, the most approved patterns of base-burning stoves give excellent results, if connected with the proper



flues; but, as usually set up, they not only give no aid to ventilation, but often are direct sources of contamination of the air of the room with gaseous products of combustion. In order to secure the greatest possible utilization of all the heat produced in a stove, it is necessary that the smoke shall pass into the chimney-flue at the lowest temperature consistent with securing sufficient and regular draught, and to this end much may be effected by such contrivances as sheet-iron drums, and so forth, which will utilize the waste heat in warming the room above." The Baltimore heater, and similar devices known as fire-place heaters, accomplish this purpose in a satisfactory manner.

### Unpleasant Quality of the Heat from an Overheated Surface.

The great mistake that is often made is in selecting a stove or furnace of too small a capacity, and therefore necessitating a hot fire and an overheated surface. An overheated surface, especially if that surface is iron, produces an unpleasant quality of heat, and is apt to be attended with injurious effects. The demand for a stove that acts promptly and heats rapidly, and thus gives off a great amount of heat in proportion to its size, such as the cast-iron cylinder stove with strong draught and quick combustion and which quickly becomes red-hot from contact with the fire, is an unfortunate one, as it tends to perpetuate the evils of this form of heating. The common cylinder stove is a cheap article, and cheapness and inferiority are apt to go together. It is always the better plan to have a larger stove or furnace than is actually needed for ordinary purposes, so that there shall be no necessity for unduly heating the surface. A reserve force is thus obtained, which will be exceedingly useful in very cold weather. Such an apparatus, when once properly heated, will retain its heating power for a long time. The small cast-iron stove, without proper lining of fire-clay, should be universally condemned. Iron, however, is a very useful material for stoves, and cannot be dispensed with. It is an excellent conductor of heat, is easily adapted to form, and is comparatively cheap. For these reasons it has been more extensively used than any other material in the construction of stoves. But it has disadvantages which should not be overlooked, since by proper construction of the apparatus and care in the management of the fire these objections may, to a great extent, be overcome. Iron heats rapidly and also cools rapidly, and is therefore not the most equable means of heating. Its liability to become red-hot is a very objectionable feature. It is a common observation, that the air of a room in which there is a red-hot stove has a burnt smell, said to be due to the charring of the organic matter. The air also becomes much too dry, and imparts an unpleasant sensation. It seems to have been determined very conclusively, that red-hot iron stoves permit the escape of gases through their walls. The effect is greater with cast-iron than with wrought-iron. Experiments have been made which prove that carbonic oxide will pass through iron when highly heated. Dr. Derby, of Boston, has called particular attention to this fact, and has assigned very good reasons for believing that headache and other injurious effects produced by iron stoves are due to the escape of carbonic oxide through the metal when in an overheated state. He recommends the following rules to be observed in burning anthracite in cast-iron stoves:

#### Rules for Burning Anthracite in Cast-iron Stoves.

1. Use fire-brick or soapstone (silicate of magnesia) in contact with the fire, and never allow the fire-pot to get red-hot.



2. Have perfect castings and as few joints as possible, and these joints should be horizontal and not vertical.

3. Never cut off the supply of air to the fire, and never check the free escape of the products of combustion to the chimney by dampers, or by cooling the fire by the admission of air between the furnace and the chimney.

4. So burn the coal that, under all possible circumstances, a pressure of air from without inwards may be exerted upon the fire-pot, radiators, and smoke-pipes.

Attempts have been made to overcome the inconvenience and evil effects which an iron stove produces, by adopting a form of construction which will, with ordinary care, protect the iron from overheating. To accomplish this object, the fire must be prevented from coming in direct contact with the iron, either by interposing a stratum of air between the fire-box and the outside covering of iron, or by lining the stove with fire-brick or earthenware. The base-burning stove is an example of the former arrangement. Another method of preventing a stove from becoming overheated is by so proportioning the heating surface to the size of the fire, as to cause the heat to be carried off with sufficient rapidity to prevent the iron from becoming excessively hot.

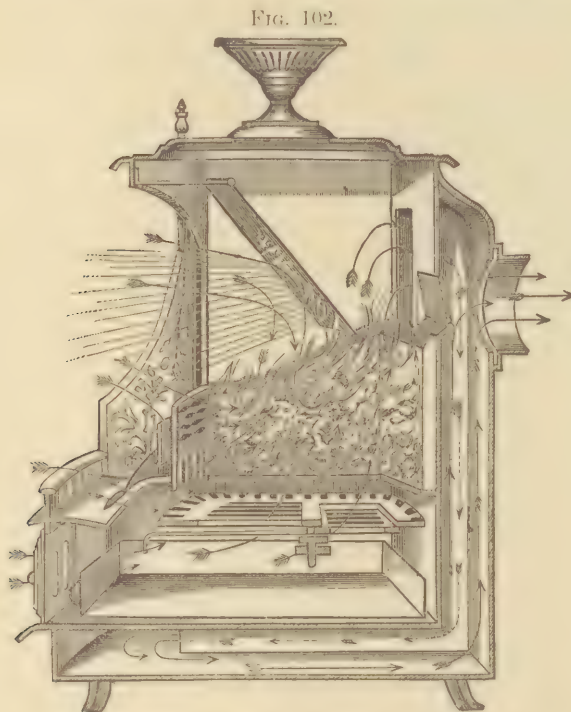
### Ventilating Stoves.

One of the great objections to all forms of close stoves is their very deficient ventilating power. The amount of air required for combustion is comparatively small. Moran estimates the amount of air consumed by a close stove at 120 cubic feet per pound of coal. This represents a ventilating power of little or no value. This objection is overcome in the so-called ventilating stoves, which are constructed on the principle of the open grate. The amount of air extracted from the room by this form of stove is very considerable, almost equalling the amount discharged by an open fire. This form of stove does not yield the best calorific results, and is therefore not a cheap means of heating; but, as Dr. Billings correctly observes, "in this climate it is impossible to have, at the same time, good ventilation, sufficient heating, and cheapness." The "Franklin" stove, one of the best known forms of the "open" stove, is shown in section in Fig. 102. By the use of a reflector and a system of revertible flues, the heating qualities are much improved, while the withdrawal of the air of the room is not materially impeded.

Fire-place stoves or heaters, of which the Baltimore stove may be taken as a type, are economical and labor-saving, but, as generally constructed, their ventilating power is inappreciable. The air supplied to the air-chamber is taken directly from the room, and when the hot-air flue is used for heating the room above, the discharge of foul air is at the expense

of the room into which it is conducted. In setting up this form of stove, provision should always be made for admitting the necessary quantity of air from outside to supply the air-chamber, and for regulating the discharge of the fresh warmed air by valves. In addition, there should be properly arranged outlets for the discharge of the vitiated air of the room. With this combination a very serviceable and healthful means of warming might be obtained.

Fig. 103, on the next page, furnishes a sectional view of a base-burning fire-place heater, which economizes heat by the use of sheet-iron drums. A stratum of air intervenes between the fire-pot and the outside casing,



SECTIONAL VIEW OF "FRANKLIN" STOVE.

and thus the liability of overheating is very much diminished. It is not intended to draw air from out-of-doors, but a very slight modification in construction would make this improvement available. The mica windows set in the circular front allow the heat and light to be transmitted into the room, and give a cheerful appearance to the fire. As very little air is discharged from the room by this form of stove, special openings should be provided in the flue for this purpose.

The usefulness of the ordinary cylinder or box stove is greatly improved by enclosing it, except in front, in a jacket or casing of sheet-iron or zinc, into which fresh air is admitted at the bottom and discharged in a heated

condition from the top. While admitting fresh air in this manner, an exit should be provided for the escape of foul air from the room. It has been suggested that when the room has a fire-place in it, and the stove-pipe enters the same flue near the ceiling, efficient ventilation might

FIG. 103.



be secured by leaving the fire-place open. Dr. D. F. Lincoln has suggested a variety of ways in which the stove or stove-pipe may be used for expelling air from a room. One of these plans consists in enlarging the opening into the chimney for the stove-pipe, so as to receive a much larger pipe, which encircles the stove-pipe like a jacket. This jacket may stop short near the floor, or it may be carried through the floor to a lower story. In either case, it will secure a draught and be useful in withdrawing foul air. Another simple device for warming fresh air, suggested by Dr. Lincoln, is represented by Fig. 104. The air is brought in from the outside by means of a pipe under the floor, and is warmed by contact with the stove-pipe. The inlet-flue is enlarged

and surrounds the stove-pipe like a jacket for some distance.

### Heating by Hot-air Furnaces.

The method of heating by hot-air furnaces is in very general use, especially in houses of the better class. It is a convenient method, and yields very satisfactory results when the heating apparatus is well designed, carefully constructed and managed, and is supplied with an abundance of perfectly pure air. But, as Dr. Billings observes, "the great majority of hot-air furnaces as actually used are unsatisfactory, and special sources of danger to health; but this is not so much the fault of the furnaces themselves as of the manner in which they are set and adjusted. They are better than stoves in this respect, that satisfactory heating cannot be secured by them without the introduction of air into the room to be heated, but the air that is introduced by them is often of a very unsatisfactory quality."



The following is a condensed statement of the points to be borne in mind in selecting and adjusting a hot-air furnace, as recommended by Dr. Billings in his recent work on ventilation and heating :

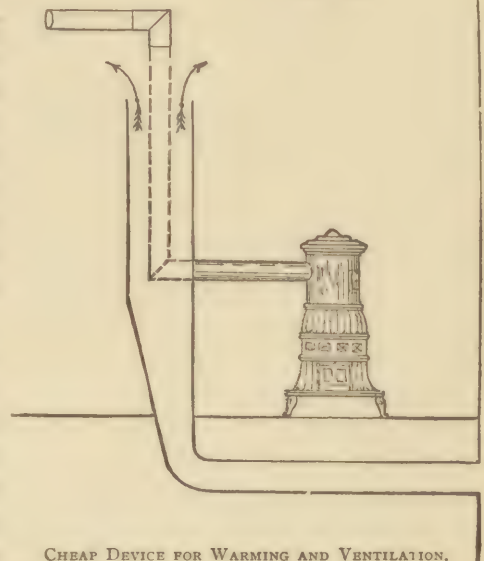
1. In most cases in which this method of heating is used in this country, the furnace is too small. The result is, that in cold weather, in order to secure comfort, it is necessary to raise the radiating surface to a high temperature, often to a red heat. The contraction and expansion due to such great changes of temperature soon loosen the joints of furnaces built up of several pieces, and permit the escape of the gases of combustion into the fresh-air supply. Of these gases, carbonic oxide and sulphurous acid are the most hurtful.

2. As furnaces are usually set, there is no provision for mixing cool air with the heated air. The result of this is, that the air is delivered in the room at a high temperature—often  $140^{\circ}$  F., and sometimes higher—and the only way to prevent the room from becoming too warm is to close the register, which, of course, shuts off the supply of fresh air.

3. The source of air-supply to a furnace is often most unsatisfactory. Sometimes it is taken directly from the cellar itself, in which case it is liable to be contaminated with gases escaping from the furnace door, while the cellar itself may contain decaying vegetables, refuse matters, or a badly trapped drain, giving free communication with the sewer; or, the air-box leading to the outer air may have so many cracks in it as to freely admit the cellar-air. In arranging the fresh-air supply to a furnace, the least troublesome and least expensive method is selected, which is generally the one which also will give the least satisfactory results.

4. A furnace is usually placed near the centre of a building, the object being to have the flues conveying the heated air from it as short and with as rapid an ascent as possible. Horizontal flues for heated air are very undesirable, as the friction in them checks the current and involves loss of heat. The direction of the wind has a great influence on the action of hot-air flues, and for this reason it is better to place the furnace not in the centre, but toward that side of the house against which the winter winds blow most frequently and strongest. In large buildings, it

FIG. 104.



CHEAP DEVICE FOR WARMING AND VENTILATION.

will be better to use two or three furnaces well distributed, than one large central one. Furnaces that have the fewest joints and the largest amount of radiating surface in proportion to the size of the fire-box, are to be preferred, other things being equal; and it is very poor economy to buy a furnace which is not large enough to heat satisfactorily, in the coldest weather, without heating the fire-pot to a red heat.

The seams of a furnace should be gas-tight, an effect seldom obtained when the material is cast-iron with seams filled in with putty or red lead. The constant expansion and contraction of the metal cracks and dislodges the fillings and leaves spaces for the escape of the injurious gases into the air-chamber, should the pressure, which is usually inward toward the fire-box, be reversed, as sometimes does happen. Under certain circumstances, a sudden puff of wind may change the direction of the pressure. To avoid the escape of gas into the air-chamber, wrought-iron should be used as the material for the outer casing of the fire-box, as it can be made thoroughly tight by hammering and riveting the edges, and as it is less permeable to carbonic oxide than cast-iron when heated to a red heat. To prevent overheating of the air supplied to the hot-air box, a liberal supply of air should be provided and be well distributed about the heated surfaces of the fire-box and drums. The openings for the escape of heat into the rooms should be correspondingly large. In this manner a large volume of moderately heated air can be supplied. When this provision is properly attended to, there is no need of vessels containing water to supply moisture to the air. But, as furnaces are usually constructed and managed, the air is dried too much, and it is therefore important that water-troughs with a large surface should be provided inside the air-box, so that the air may be properly moistened before it enters the room. These troughs require frequent cleansing, as deposits from the water will, in time, become offensive, and give an unpleasant, if not injurious, quality to the air.

It is the custom to place a valve in the chimney or smoke-flue, called a "damper," for the purpose of checking excessive draught by partly closing the passage way for the escaping smoke and other products of combustion. This is an unnecessary and dangerous expedient: unnecessary, because the draught can be controlled at the point where the air enters the fire; and dangerous, because the gases from the fire-box are very likely to pass through the joints of the stove into the air-chamber, when the opening into the chimney-flue is closed. For these reasons a damper should never be placed in the smoke-flue of a furnace or stove. In Germany, the damper is depended on to cut off the draught and retain the heat in the large china stoves so commonly in use, and the result is frequent cases of fatal poisoning by the gases which escape into the room because their exit by the chimney is prevented.

To diminish the draught in a furnace or stove, an opening is sometimes made in the smoke-flue before it enters the chimney, which admits air to the flue without obstructing the passage of the smoke. This device should not be resorted to, as it may unduly cool the smoke-flue and lessen the pressure exerted on the outside of the stove, which it is desirable to constantly maintain as a means of protection against the escape of the gases.

### Heating by Means of Gas.

Heating by means of gas is a very convenient and cleanly method; but, as only a minimum quantity of the total heat produced by combustion can be made available when a proper channel is provided for the escape of the gaseous fumes, it is not as economical as coal, except under circumstances requiring its temporary use. For heating bath-rooms and spaces where a fire is not permanently required, and cannot be conveniently employed, the gas-stove serves a useful purpose and is economical, as its full action can be quickly obtained, and as quickly dispensed with after the immediate want has been supplied.

Gas is not much used in this country as a permanent means of warming; but as a ready means of obtaining heat for domestic purposes, as in the laundry, in the kitchen, and for the bath, its use is being gradually extended. When it is desirable to dispense with the range-fire, to prevent the air of the house from becoming overheated, as in the hot summer weather, the gas cooking-stove forms a most convenient substitute.

The use of gas as a heating agent is capable of great development; and there is no doubt, that, in the future, it will be made available as a desirable substitute for coal in our houses. Already, scientifically-constructed gas ventilating-stoves have been produced in England, which afford a plentiful supply of fresh, warmed air, that may be maintained at any temperature, and which require no attendance, and create no dust in the room. Provision is made for the escape of the products of combustion, a matter of the greatest importance whenever gas is burned in any considerable quantity. Gas used in this way is not as economical as coal, and this is one of the drawbacks to this system of heating, which may, in time, be overcome. Mention may be made of George's calorigen stove, an English invention, which is said to utilize a large percentage of the value of the fuel, and to afford an equable warmth with good ventilation. This stove is made of thin, rolled-iron, and is closed at the top and bottom, in order that the burners inside shall have no communication with the air of the room. It contains a coil of tubing, into which air is drawn from an external source, and moderately heated in its passage through it before being discharged into the room. On the outside of the wall is a cylinder, open only at the top, which is connected with the stove by two tubes. The lower one supplies the burners with



the necessary air, while the upper one carries away the products of combustion. The fresh air thus admitted to the interior of the stove, mingles with the heated air, and thus there is a saving of heat. The arrangement is a perfect one for permitting the combustion of gas without allowing the fumes to escape into the room.

### Heating by Means of Steam.

In this country steam is very generally used for heating all large buildings, such as public buildings, factories, stores, and so forth; but this method has never been employed to any considerable extent for heating dwelling-houses. It is too complicated and expensive a method for application in private houses, unless the steam can be supplied in the manner that gas and water are delivered to houses, by corporations, and charged for, according to the amount consumed. The feasibility of this plan is being tested in some of our large cities; but there are so many conditions upon which its success depends, that it is hardly probable that it will ever be generally adopted, except in business sections, where steam is used as a motive power as well as a means of heating. For dwelling-houses, especially those of the smaller class, this means of warming has no applicability.

Steam used for heating is usually supplied by a horizontal tubular boiler, enclosed in brick-work. For convenience, it is located in the basement, though it is not necessary that the boiler shall be on a lower level than the heating surfaces. The fire is placed underneath the boiler, and the products of combustion pass beneath it, and return from back to front, and then pass back again over the top, and escape by the smoke-flue. The steam is conducted through wrought-iron, welded tubes to the places to be heated, where it is passed through radiators composed of coils of similar tubing, or other forms of radiators, and then is returned in a condensed form to the boiler, or to some other outlet. It is sometimes the practice to construct an air-box in the cellar, and supply it with a nest of tubes through which the live steam circulates. Fresh air is admitted from out-of-doors, and is made to pass through the coil, and, after being warmed, is distributed by means of pipes and registers, as in the case of furnace-heated air. When proper outlets are arranged in the room for the escape of air, this method is very satisfactory.

It is a very common practice to place coils or radiators in rooms to be heated, without any provision for the entrance of fresh air, or for the escape of foul air. Under such circumstances, a room will become extremely uncomfortable, and its prolonged occupancy will be likely to produce headache and oppressive feeling. The proper arrangement, as Dr. Lincoln suggests, would be to have each coil enclosed in a box, with an inlet for fresh air, and an outlet, or register, to discharge it into the

room. To complete the arrangement, there should be an outlet for the escape of air from the room, such as is afforded by the open fire-place.

The great advantage of steam-heating is that it affords a high temperature in the radiators or coils, which is effective in rapidly warming the air. With a high temperature, there is also obtained a large proportion of radiant heat, which warms the walls and furniture in the same way that an open fire-place does. A steam apparatus is rapidly set in operation; and, when desired, it can be as rapidly cooled down by shutting off the supply of steam. This method of heating has its disadvantages. Prominent among these, is the annoyance caused by the unpleasant noises which frequently occur "when a small volume of steam in some way is interposed between two columns of cooled water that instantaneously condenses it and forms a vacuum, bringing such columns into solid contact with each other." Leaks will occur, and explosions are possible; but all these objections may be overcome by selection of good material, careful workmanship, proper grading and arrangement of the pipes, and by automatic adjustments.

Waste of heat may be guarded against by coating the mains with non-conducting substances, the basis of which is generally asbestos. Where the pipes come in contact with wood-work, proper guards should be used to avert the dangers from fire.

### Heating by Means of Hot Water.

Heating by hot-water pipes is comparatively little used in this country. The apparatus, in its simplest form, consists of a continuous iron tube, united at both ends, and filled with water. One part of the tube is coiled in some suitable form and placed in the furnace, and the other part is distributed throughout the building, to form the surface which gives out the heat. The water in the coil becomes heated, and flows out at the top, while the water in the other parts of the tube, being cooler, passes into the coil at the bottom, and thus a constant circulation of heated water takes place so long as the fire is kept up. This method is a convenient and safe one; and it has the further recommendation of constancy, regularity, and mildness of temperature. On the other hand, it should be remembered, that the apparatus is slow in heating when it has once become cooled, and this will occur during the night if the fire is not attended to; and, moreover, it is expensive, and therefore not well adapted for heating ordinary houses.

### Methods of Warming and Ventilating the Whole House.

In warming a house, it is advisable to make provision for warming the air of the hall and staircase as well as of the various rooms. If this is

not done, the cold air will penetrate into the rooms, even when the doors are not left open, and much of the benefit of the contrivances for heating them will be lost. In the majority of the better class of houses, it is the custom to depend on one or more furnaces, located in the basement, in which fresh air is heated by means of a stove, or hot-water pipes, or steam-coils, and then distributed to the hall and passage-ways and rooms by means of flues fitted at their outlets with registers, containing valves for the regulation of the escaping air. The foul air escapes by the fireplace, or through openings made in the chimney-flue, or in special ventilating-shafts. In some cases, the furnace is used for heating the hall and stair-case, and open grates are located in the principal rooms for ventilation, and as a means of supplementing the heat of the furnace, which may be admitted by suitable openings in the partitions or through the doorways. This, of course, is an expensive method; but where economy is no consideration, it may be adopted with the best results. This plan is similar, in its main features, to the one recommended by Mr. Ritchie, which consists in supplying warm air to the hall and stair-case, from which it is admitted to the various rooms by openings over each door. After being diffused through the room, the air is discharged through the chimney, or through special flues leading to the top of the house.

Drs. Drysdale and Haywood, of Liverpool, have devised a plan for heating the whole house, which is somewhat similar to the one just mentioned. Fresh air is heated in the basement by a coil of hot-water pipes, and is then conducted to the central hallway, from which it is admitted to the rooms by suitable openings, provided with valves to regulate the supply. The vitiated air passes out of the rooms by central openings in the ceiling, and passes to a foul-air chamber at the top of the house. From this chamber it is drawn by the kitchen fire, through a down-cast shaft, down to the ground-floor, and then is expelled through an outlet-shaft round the smoke-flue. It is objected to this plan, that it is a waste of power to draw the air from the top of the house to the basement-floor, when it might just as readily be expelled without taking this circuitous route.

Another method of warming and ventilating the whole house, is the one introduced some years ago by Dr. Griscom, of New York. In this plan, the chimney of the furnace-fire is utilized to withdraw foul air through pipes located contiguous to the hot-air flues. The heated air is admitted near the skirtings of the rooms, and the foul air is abstracted through openings fixed close to the ceiling. The foul-air flues are gradually enlarged on their passage to the chimney top. The principal advantages claimed for this system, are its constant action and the facility of warming and ventilating each room, independent of the others. Many other methods of warming and ventilating the whole house have been proposed, but the above examples will be sufficient to illustrate the principles upon which these systems are usually based.



### **Extraction of Foul Air by Other Means of Heat.**

It is rarely the case that special means for heating ventilating-flues are required in ordinary buildings. In cold weather the heat used for warming, and that produced by lights, can be utilized for extracting the foul air; and, in summer, open windows and doors will afford, in most cases, ample means for change of air. But there are times when it is too warm to permit of the use of heating apparatus, and when artificial means are required to assist natural ventilation. This may occur, though rarely, in private houses, but is especially the case in buildings where large numbers of people are gathered together. In dwelling-houses, very satisfactory results may be obtained by running up in the walls, tubes or flues of tin or zinc, which have their outlets above the roof, and are protected from the weather. These tubes or flues are provided with gas-jets, as a convenient means of heating the air, thereby causing a steady upward current in the shaft. Such means of ventilation are very useful in old houses, in which it is not practicable to introduce other kinds of apparatus; and they are of special utility in ventilating water-closets, and other spaces, which, from their peculiar locality, cannot be conveniently included in the general system of ventilation.

In large buildings, the foul-air extraction-shafts are frequently required to be heated by other means than the usual heating apparatus. The heat may be applied in various ways. A common plan is to fix a stove or an open grate at the bottom of the shaft in such a manner that the air in the shaft can be properly heated without necessarily heating the building. The foul-air flues from the different parts of the building are conducted into the shaft as near as possible to the fire, and care is taken to prevent air from reaching the shaft, except through the tubes. Another means of heating the air of an extraction-shaft is by coils of hot-water or steam-pipes, suitably arranged within the flue.

### **Extraction by the Aid of Gas-lights.**

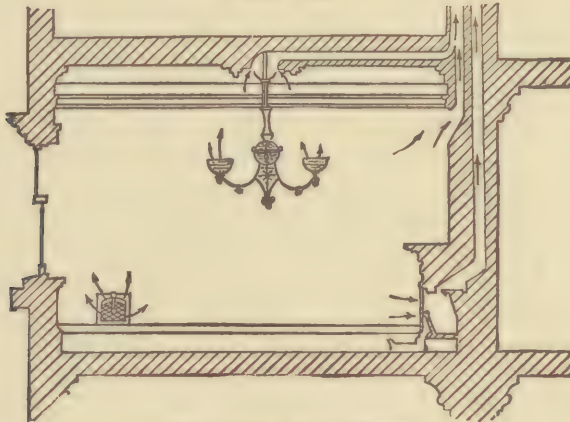
When gas is burned in any considerable quantity, it is advisable to provide a means of escape for the products of combustion, which help to render the air impure. This may be done by very simple contrivances, such as a tube with a funnel-shaped end arranged above the burner and leading into a flue, or directly out-of-doors. Perforations may be made in the ceiling above the chandelier, and concealed by an ornamental piece of stucco. But, while specially providing for the escape of the gaseous products of combustion, advantage may be taken of the heat produced by illumination in drawing out the vitiated air of the room at the same time. This plan has been adopted in theaters and other large buildings with satisfactory results. General Morin has determined, by experiments, that the burning of one cubic foot of gas will cause the

discharge of 1,000 cubic feet of air. From this it will appear that an ordinary burner, which consumes about five cubic feet of gas per hour, has an extractive power which can be utilized for removing 5,000 cubic feet of air in the same time. It is, therefore, obvious, that, with very little adaptation, gas-lights may be very advantageously employed for the purposes of ventilation.

In Fig. 105, used by Dr. Billings to illustrate a part of the plan of ventilation and heating adopted in the Union League Club, of New York, is shown the manner in which the extractive power of gas-lights may be utilized, not only to remove the products of combustion, but also a very large amount of vitiated air of the rooms.

The so-called "ventilating-globe lights," of which there are a number of patterns in use in England, deserve a more extended application, on account of the completeness with which they carry out the objects just

FIG. 105.



VENTILATION BY GAS-BURNERS.

mentioned. The flame may be fed by bringing in a special supply of air from the outer atmosphere, or it may be supplied in the ordinary way by the air passing through the room. The gaseous fumes escape by a central tube leading from the burner to a flue. So soon as the gas is lighted, the air in the main tube becomes heated, and heats the air in the surrounding tube. The effect of this is to cause an active movement in the air of the room toward the openings in the ceiling, through which it escapes to the chimney or to a special exit-shaft.

#### Extraction by the Steam-jet.

A current of air may be caused in a flue or chimney by the force of a steam-jet. This means of extraction may be advantageously used in factories where there is an abundance of spare steam, but the plan has never been considered suitable for general use.

### Extraction by a Fan or Screw.

The application of mechanical power through a fan or screw as a means of extracting air has been adopted in mines, and, to some extent, in the ventilation of large buildings. In removing particular impurities with great rapidity, such as the dust of cotton, steel-filings, or injurious emanations produced in the workshop, this system of extraction is of the highest value. It has been proposed to use the Archimedean screw in the top of a chimney to be driven by the wind as the motive power for extracting the air; but the objection to this plan is that the motion is uncertain and weak. Better results are obtained by working the screw by steam power.

### Ventilation by Propulsion.

This system of ventilation is carried on by the direct application of power to a fan or wheel enclosed in a box, by means of hand, horse, water, or steam power, generally the latter. The air is passed into the box at the centre of the fan, and is thrown by the revolving fan into a conduit, from which it is distributed through proper channels to the different parts of the building. It might be supposed that when air is thus forced into a room, all the foul air would be expelled by the cracks in the windows and doors, even if special outlets were not provided for its escape; but, in practice, this result is not always obtained. The air forced into a room tends to escape by the most direct outlet before perfect distribution has taken place, and, unless provision be made for extracting the air uniformly from all parts of the room, this system may not be successful as a means of purifying the air. It is therefore frequently the practice to combine the system of propulsion with that of extraction.

In hospitals, theatres, and large assembly rooms, the system of propulsion has had an extensive application. Its advantages are the certainty and ease with which the air can be distributed wherever it is wanted. The temperature of the air, and its quality, to some extent, can be regulated at will. The air can be taken from any point, and can be washed, if necessary, by passing it through a thin film of water thrown up by a fountain; and it can be warmed or cooled to any degree required. The disadvantages of the system are its great cost and the liability to derangement of the machinery, and the consequent stoppage of ventilation. A reserve force may be required to meet this latter contingency.

As to the relative merits of these two systems, there appears to be a diversity of opinion. If there be a preference, it is probably in favor of the system by extraction. However, the choice is one which must be determined by the special conditions in the case.



These systems are confined, in their application, almost exclusively to buildings occupied by a large number of persons. For dwelling-houses, it is unnecessary to provide special mechanical appliances for renewing the air, since a change of air can be effected by the forces of natural ventilation, assisted by such powers of extraction as may be had by utilizing the heat generated in warming and lighting.

### Description of Inlets and Outlets.

Window ventilation may be depended on during a large portion of the year in effecting a thorough renewal of the air of a room. It may happen that the windows are not properly situated to secure the perflating force of the wind. In the cold season, the windows must be closed to keep in the heat, and in hot climates it may be necessary to keep them closed to exclude the heat. It therefore becomes necessary to provide special arrangements for the admission of fresh air, and for the extraction of foul air.

As already observed, the air should be taken from a pure source, and no chance of contamination during its passage into the house should be permitted. The channels for the passage of air should, as a rule, be short, and they should also be as direct as possible and easily accessible; otherwise dust and dirt will collect in them, and render the air in its passage impure. It is better to have a number of small inlets well distributed than to have one large one. When inlets are located in the outer wall they should be protected from the wind by hoods or valves. Perforated bricks or wire gauze may be used for checking the direct pressure of the wind.

### Relative Position of Inlets and Outlets.

As to the relative position of inlets and outlets, there is a difference of opinion. Theoretically, the proper place for the entrance of fresh air is at the bottom of the room, and that for the escape of foul air is near the ceiling. But, unless the air is warmed, it cannot be admitted near the floor without chilling the feet and causing discomfort. The proper place of entrance is about nine or ten feet from the floor or near the ceiling, and the openings should be so arranged that the cold air may be directed toward the ceiling and mix gradually with the other air of the room. When the air is warmed, it may be admitted at or near the level of the floor.

When there are no means of heating the air passing through an extraction-tube, the outlets should be placed at the top of the room, which is the point of greatest discharge. If means of heating the air be provided, it is not important where the outlets are located. Outlet-tubes should be as straight as possible, and should have smooth interior surfaces, so as not

to impede the movement of air. The circular form is preferred on account of the friction being less than with any other shape. Some form of cowl is required to keep the rain from entering the exposed end of the shaft. Such a cowl should be selected as will aid the aspirating power of the wind. Outlet-tubes should not be placed in external walls if it can possibly be avoided, as, in this position, their efficiency is greatly diminished by the action of the wind and the cooling of the walls. Draughts may take place through an outer wall, and interfere with the current of air in the ventilating-shaft. Outlet-shafts should therefore be made as nearly air-tight as possible, and if made of glazed terra-cotta pipes, or of tin or zinc, they will satisfy this condition, and also serve to lessen the friction, which is quite considerable in a roughly plastered flue.

The discharge of foul air is much more constant and certain when artificial heat is used. There is no better outlet than the open fire-place. The heat produced by heating apparatus and by lights can be utilized for getting rid of vitiated air.

#### The Size of Inlets and Outlets.

It is a difficult matter to fix the size of special openings, whether intended for inlets or outlets, since the conditions met with are so variable. The only way out of the difficulty is to fix a size that will meet the majority of cases, and that will be capable of alteration according to circumstances. According to Dr. Parkes, a size of twenty-four square inches per head for an inlet, and the same for an outlet, is that best adapted to meet common conditions.

Theoretically, the sectional area of outlets should be larger than that of inlets, as heated air expands. Practically, however, this difference may be disregarded, and both openings may be made of the same size. A number of small inlets are to be preferred to one large one, as a better distribution of the air is effected. An individual inlet, according to Parkes, should not be larger than forty-eight to sixty square inches in area, and an outlet should not be more than one square foot. In dividing up the total sectional area into smaller areas, allowance must be made for the loss by increasing friction.

## CHAPTER III.

### LIGHTING.

ARTIFICIAL light is generally produced by heating some body to such a degree of temperature that it becomes incandescent. If a body becomes heated to a higher temperature than that of surrounding bodies, it throws off some of its energy in the form of radiations. If this temperature be low, these radiations do not affect the sense of sight, but are felt as warmth. If the temperature be increased, other radiations are emitted, which become visible as red light. At a still higher degree of temperature the body attains a white heat, and the rays which it throws out are perceived by the eye as white light. The color of the light which a heated body gives off, therefore, bears a certain relation to the elevation of temperature. For example, a bar of iron moderately heated causes the sensation only of warmth. If the temperature be raised to a particular point, it becomes red-hot; and if still further increased, a white heat is obtained. In the production of artificial light, the object, therefore, is to raise some substance to such a degree of temperature that it shall give out as large a proportion as possible of those rays which are perceived by the sense of sight.

#### Methods of Artificial Illumination.

Until quite recently, the incandescence required for artificial illumination was obtained exclusively through the agency of heat developed by chemical action, or what is called combustion. The recent practical application of electricity to the purposes of illumination has made available another source of light, which is due to the "energy of current electricity." With the older illuminants, the source of light depends on the "energy of chemical affinity."

#### Nature of Illumination from a Flame.

In all ordinary cases of combustion, the process is one of oxidation, the chemical action lying between the burning body and the oxygen of the atmosphere. The materials found most convenient and economical, in



practice, for the production of heat and light, are mainly carbon in combination with a certain proportion of hydrogen and oxygen; and the process of combustion is one of rapid and violent oxidation of the carbon and hydrogen by the aid of the free oxygen supplied by the air.

In burning hydrocarbons, the luminosity in the flame is due to the high temperature produced by the act of chemical union. Hydrogen has a much greater affinity for oxygen than carbon has, and consequently takes up the greater proportion of the oxygen surrounding the flame, producing intense heat, and separating hydrocarbons rich in carbon and in a state of vapor of great density. The hydrocarbons being intensely ignited in the hydrogen flame, become brightly luminous; and then, in turn, undergo oxidation at the outer edge of the flame, and conversion into carbonic acid and water, and sparingly into carbonic oxide. The principal products of combustion are carbonic acid and water. Under certain conditions, there may be also carbonic oxide, sulphuric acid, and ammonia. The abstraction of oxygen from the air and the production of carbonic acid gas are the disadvantages which pertain to the ordinary methods of illumination. The heat generated in the production of light may also be a disadvantage, unless utilized in getting rid of the products of combustion, and in discharging air vitiated from other sources.

### The Electric Light.

The electric light differs from the other illuminants in the mode of production. It is not the effect of combustion, but of a current of electricity in passing through a resisting medium, such as a gas or a small wire. If electricity be passed through a conductor which impedes its current, the conductor becomes intensely heated to a degree proportionate to the amount of resistance encountered, and emits a brilliant light. Carbon is the substance used as a conductor, as it is able to withstand a high temperature without liability to fusion.

### The Incandescent Electric Light.

If a slender filament of carbon while exposed in the atmosphere, is heated to whiteness by the resistance of the electric current it will speedily be destroyed. It is therefore necessary to protect it from the air by enclosing it in a sealed glass globe from which all the air has been extracted. Thus far the best results have been obtained by using a delicate filament of carbon, arranged in the form of a loop in a glass globe exhausted of air. When this carbon filament is heated by its resistance to the passage of an electric current, it becomes incandescent, and produces a steady and brilliant light. This is the so-called incandescent light *in vacuo*; and it is thus far the only form of the electric light which is at all suitable for domestic uses.

The Edison incandescent lamp is one of the best forms, and may be taken as a type of this new method of illumination. The accompanying illustration, Fig. 106, represents such a lamp adapted to the dwelling.

FIG. 106.



EDISON INCANDESCENT ELECTRIC LAMP.

The delicate filament within the glass enclosure is composed of charred card board, and is the material that becomes incandescent during the passage of a current of electricity, and emits the light. Should anything happen to the globe, it can be easily removed and another substituted for it. At the permanent part of the fixture, there is a key for turning the current on or off, just as is done in a common gas-burner.

### The Electric-arc Light.

If two rods of carbon are placed in contact with each other, and an electric current of sufficient power be passed from one to the other, the current will not cease when the rods are slightly separated, but will leap across the intervening space, causing an intensely high temperature and a brilliant light. The luminous track thus formed between the two carbon points is called the electric arc, and upon this principle is founded the well-known form of the electric-arc lamp.

If the current of electricity be continued, the pieces of carbon are gradually burned away, and the interval between them increases with the effect of gradually diminishing the light; and if it extend beyond a certain limit, the current of electricity is unable to pass from one piece to the other, and the light goes out. It is therefore necessary to provide mechanism to bring the carbons together and then part them, or simply part them if in contact when the light is first started or accidentally goes out, and also to regularly approximate the carbons as they are consumed. As the automatic adjustment of the carbon points cannot be absolutely uniform, the light is more or less variable; it flickers and gradually wanes and then brightens up again at short intervals, according to change

in the electric current, and in the distance between the carbon points. The varying densities of the light, from the heterogeneous nature of the carbons, cause muscular fatigue to the eyes, and also render images on the retina indistinct. On account of these inconveniences and the dazzling brightness of the light, the electric-arc lamp is not suitable for domestic uses.

### Advantages of the Electric Light.

The electric light has advantages that are unequalled by any other form of illuminant. It is more like sunlight than any other in use, and its brilliancy causes it to be unexcelled as an artificial means of illumination. With proper arrangements, it affords the clearness and defining power of daylight. The heat produced by it is hardly appreciable, and, when enclosed in sealed vessels, it has no effect whatever upon the gases of the atmosphere. It consumes no oxygen and produces no noxious compounds, and therefore has no part in vitiating the atmosphere or in injuring articles of furniture, books, pictures, and so forth, which are so often seriously damaged by the products of combustion of the ordinary illuminants. With these advantages, there can be no doubt, that, before long, the problem of electric lighting will be solved to the advantage of the public. At the present time the incandescent light *in vacuo* is the form best adapted for domestic use, not only on account of its superior illuminating power, but also on account of its chemical and sanitary advantages. It is, however, not yet available for general purposes, by reason of its expensiveness, and the want of perfection in the details of its application.

### Ordinary Means of Artificial Illumination.—Gas and Gas Lighting.

The sources of artificial light in common use are gas, the mineral oils, and solid and liquid fats, which are employed in the form of candles, or are burned in lamps.

Illuminating gas is very extensively employed on account of its economy, cleanliness, and convenience. If skillfully prepared from the best materials, and properly purified before distribution; or, in other words, if the quality is good, the resultants of the combustion of gas in moderate quantity need not be injurious to health, if the ordinary means of ventilation be provided. But as commonly prepared and sold, it is of inferior quality, and contains impurities which need not form any part of its composition. Under these circumstances, the products of the combustion of coal gas are more than ordinarily noxious, as may be inferred from the damage they cause to books, paintings, plates, furniture, and so forth, and from their injurious influence upon health.



### Evils and Inconveniences of Gas.

The heat developed by the combustion of ordinary illuminating gas is an inconvenience, unless utilized as a means of ventilation. It dries the air to such a degree as often to render it irritating to the surfaces of the eyes, and, indeed, to the lungs. The abstraction of the oxygen from the air to supply the flame is very considerable. According to Mr. Slater, every cubic foot of ordinary coal gas, giving fifteen candles for five cubic feet per hour, requires for its perfect combustion 1.17 cubic feet of oxygen; so that in a room lighted for two hours by three good burners, the gas would require 35.1 cubic feet of oxygen. The formation of deleterious vapors is, however, the main serious disadvantage. The products of coal-gas combustion are principally aqueous vapor, carbonic acid, carbonic oxide, and sulphuric acid. The formation of sulphuric acid, by the oxidization of the bisulphide of carbon, found in impure gas, exercises an injurious influence upon books, paintings, and metallic surfaces, and so forth. When gas is only partly burnt,—an occurrence which takes place when improper burners are used, or when the pressure of the gas is excessive,—a considerable quantity of carbonic oxide escapes into the air, and forms a dangerous impurity.

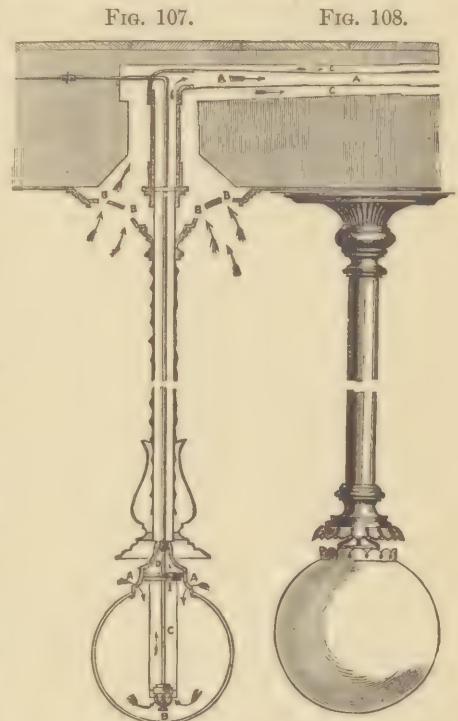
The main constituent of the products of combustion is carbonic acid. It has been found, by actual trial, that one cubic foot of coal gas produces about two cubic feet of carbonic acid in combustion. As a common gas-burner consumes about five cubic feet of gas per hour, and produces many times as much carbonic acid as a man in the same time, it is evident, that, from this source alone, the air of a room will become quickly vitiated, unless some means be provided for removing the products of combustion, and for supplying fresh air.

### Special Outlets for the Products of Combustion of Gas.

Under ordinary circumstances, it may not be practicable to provide special outlets for the products of combustion of lights, however desirable it may be; and therefore the removal of these impurities must be accomplished by the means adopted for the general ventilation of the room. It has been recommended that, wherever a gas-burner is fixed, a tube for conveying these products into a ventilating-flue, or into the outer air, should always be provided. The unsightliness of such an arrangement would be its main objection; still, there are instances in which this plan is advisable for the burners that are in constant use, the necessity of which must be determined in each individual case. With portable gas-lamps, such as the Argand burner, with flexible tubing, an arrangement of this kind would be impracticable. There is, however, a method of getting rid of the noxious products of gas burning, and at the same time withdrawing a very considerable amount of the vitiated air of the room, which has

not the objection of unsightliness, and cannot be safely dispensed with where chandeliers are constantly used. It consists in having openings made in the ceiling, above the chandelier, leading into a tube of tin or zinc, which is carried beneath the floor of the room above, into a foul-air shaft or chimney. The openings may be concealed by the centre-flower, which can be made to stand out from the ceiling one or more inches, without appearing to be separated from it. If the aggregate of the apertures amounts to one square foot, it is estimated that the extraction of from 10,000 to 20,000 cubic feet of air per hour will be secured. It should be observed, that when gas-burners are suspended from the ceiling in a confined space, the effect of overheating the air in the upper part of the room is to prevent the ascent of the air vitiated by respiration, which, though heated, is still heavier than the excessively gas-heated air above. It thus practically reduces the cubic space of the room almost the same as if it were materially separated on a level with the gas-burners.

The necessity of removing the noxious products of combustion from gas-lighted rooms has caused many attempts to be made to construct a form of burner that will carry out this object, and, at the same time, aid in the removal of the air vitiated by respiration. Among these contrivances we may mention the so-called ventilating-globe light, which is said to be satisfactory in its operation, and not unsightly in its appearance. The



THE VENTILATING-GLOBE LIGHT

accompanying illustrations are borrowed from Mr. Brudenell Carter, who describes the light as follows: "Its operation will be understood by the sectional drawing given in Fig. 107. The air of the room in which the light is fixed enters near the top of the globe at A, and, passing between the interior of the globe and the exterior of the chimney-glass, descends to supply oxygen to the burner B. The products of combustion ascend to the top of the chimney-glass at D, under the aperture of the hollow pendant, up which they are impelled by the sharp draught of the heated current. Having reached the upper part of the pendant, the heated products are turned by the elbow at the top into the horizontal pipe A A,

and are carried into the chimney of the room in which the light is fixed.

"The pipe A A is surrounded by an outer pipe C C, which affords—where the draught in the chimney is sufficiently good—a means of gently and imperceptibly changing the atmosphere of the room by the steady current which is produced by the heat of the inner pipe. The openings B B, provided in the ceiling-rose for the purpose, communicate through the cone with this pipe, so that the temperature of the room is equalized by the constant, gradual rise of the comparatively cool air from below, as fast as the upper portion passes into the pipe. This action is self-regulating, the current being more rapid when gently heated, and less so as the cooler air ascends.

"Burners of the same kind are made to project from the walls of rooms near the fire-place, the hollow pendants curving downwards from their points of fixation. The actual burners employed are essentially Argands, but of peculiar construction.

"As will be seen in Fig. 107, the supply-pipe descends to them from above, and passes through the ring of the burner to enter a curved cross-pipe, the extremities of which deliver the gas into a small chamber below its apertures of final exit for combustion. In this chamber it is able to expand, and to lose a portion of the pressure to which it was previously subjected, much in the same way as in the Silber batwing.\* Lighting is accomplished by passing down a spirit-torch or wax-taper from above the top of the chimney-glass; and the supply of gas is usually regulated by a tap in some convenient position, at a distance from the burner."

This light affords a good illumination, and is most satisfactory for ventilating purposes. The main objection to it is its cost.

### Dangers from Leakages of Gas.

Some of the dangers and inconveniences attending the use of gas may be alluded to and cautions with respect to them advised. Leakages of gas will sometimes occur; but, on account of the offensiveness of the smell, the defect is quickly made known, and no danger from an explosion need be feared if proper precautions are used. Gas and atmospheric air, when mingled in certain proportions, form an explosive mixture, and if a light be brought in contact with it, a violent explosion is apt to take place. In all cases of leakage, the first thing to do is to turn off the gas at the main, and then throw open the windows and doors to allow the air to sweep through the house. The gas may then be turned on and search be safely made for the leak, with a candle if necessary. Explosions may be dreaded, but the effects of inhaling gas are quite as serious. Fatal cases of poisoning from this cause are occasionally brought to notice.

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\* The Silber batwing burner is a combination of two common batwing slits; the lower one feeding a small chamber from which the upper one gives an outlet.



This accident usually takes place in the night, during the unconsciousness of sleep. The burner may be improperly turned off, thus gradually filling the room with gas. This is often due to improperly constructed burners, which are unprovided with the necessary guard. In extinguishing the light, the valve is again opened, and the gas escapes unnoticed at the time. Gas escaping through a carious piece of pipe, or through a defective joint in the main, may be conducted a long distance and gain admission to the house through the basement floors or foundation walls. Whenever the odor of gas is detected, search should at once be made for the leak, and when undiscovered in the house, a leak in the outside main should be suspected and steps at once be taken to have it repaired.

It is not a safe practice to turn off the gas at the main at night, as it may sometimes happen that a burner in use at the time may be overlooked, and when the gas is turned on again on the succeeding evening, it will escape; it may be in some unfrequented part of the house, and while being incautiously searched for may lead to an explosion. It would seem needless to caution any one about the danger of blowing out a gas-light upon retiring to rest, if accidents from such ignorance of gas did not occasionally occur. A case of this kind recently happened in one of our large cities, and similar cases do not rarely occur. A man and wife from the country had made their first visit to the city. Before retiring at night, the gas was blown out, and the effect was not observed. Fortunately, some members of the household discovered the smell of the escaping gas, and at once having a suspicion of the source, proceeded to the room of the guests, whom they had difficulty in arousing. This experience was a lesson to the strangers and should be to others.

The occasional derangement of machinery at the gas works, or obstruction to the passage of gas from some cause or other, not omitting the effect of "strikes," may deprive the household of the accustomed supply of gas. It is therefore advisable to have always on hand a supply of candles or a lamp, to avoid inconvenience or embarrassment under the circumstances stated.

#### **The Cause of Flickering of Gas.**

The annoyance caused by the flickering of gas, due to an accumulation of water in some part of the gas-pipes,—a not infrequent occurrence when the wet-meter is used—may be obviated with little difficulty by having a small pipe introduced in the lowest part of the main, which may be of use in emptying the pipes of any water that may have collected in them.

#### **Variations in Pressure.—The Use of Governors.**

The variable pressure of gas in the mains will give rise to great inconvenience and waste, unless regulated by contrivances within the dwelling. A sudden increase of pressure, which may occasionally happen during the evening from the sudden shutting off of gas in large

buildings, will cause the flame to blaze up and sing, and unless some one be present to regulate the burners, the partly consumed gas will escape into the room with unpleasant effects. On the other hand, a sudden diminution of pressure may be attended with unpleasant consequences, especially if followed by the opposite condition. When a burner is turned down very low, a slight variation in pressure may cause it to flicker and possibly go out, or a puff of wind may have the same effect; the gas will then escape into the room. This may occur after one has retired at night, and the consequences may be serious. Every dwelling in which gas is laid on is provided with a stop on the main for regulating the supply. It is, however, inconvenient to adjust this according to the pressure, and therefore a contrivance called a "governor" has been invented. This is placed on the main just within the meter; and, as its action is automatic, it maintains a tolerably equable pressure in the pipes. It is certainly a great convenience, and it also has the claim of preventing waste of gas. In large establishments there may be fluctuations in the pressure due to internal causes. These are to be met by the application of a governor to each burner.

For the sake of convenience, it is customary to light the gas in a bedroom and turn it down very low until the room is occupied. A small gas flame is also made to do service as a night light in a sleeping apartment. It is an error to suppose that on account of the smallness of the flame no appreciable vitiation of the air can take place. It is true that a small flame does not produce as much heat, consume as much oxygen, nor discharge as much carbonic acid as a large one; but, on account of the imperfect combustion incident to a weak flame, partly-consumed hydrocarbons and other noxious products are given off by it, and these impurities give to the air of a room that has been closed with a dimly burning gas-flame in it a peculiar smell, which can at once be detected by any one who has just come from the fresh air outside. For a night light, a taper burning on the surface of pure sperm-oil and the vessel set in the fire-place will answer every purpose; but it is well to accustom one's self to sleep in darkness.

#### **Petroleum as an Illuminating Agent.**

As an illuminating agent, petroleum ranks next to gas in importance. It is the natural product of certain geological formations, and is found widely distributed over the globe. Vast deposits of this mineral oil are found in America, particularly in the State of Pennsylvania, where the yield of oil is many millions of gallons a year. Oil suitable for burning in lamps is prepared by a process of distillation. The refined oils vary somewhat in color and in other features, according to the particular make; but, so far as the illuminating power is concerned, they do not differ materially.

### **Qualities of Good Oil.—Importance of the Flashing-point.**

The main quality which a good oil should possess is security from explosiveness. This is provided for by laws in the various States, which prohibit the sale of any petroleum by retail which has a "flashing-point" below 100° F. "The flashing-point is the temperature at which the vapor given off by a sample of oil takes fire by contact with a flame, which lies a few degrees lower than that at which the oil itself takes fire and continues to burn."

### **Dangers of Petroleum.**

When petroleum was first introduced into common use, explosions were of frequent occurrence, partly on account of the low flashing-point of the oil, and partly on account of the construction of the lamps. These objections have been overcome, and at the present day explosions of petroleum lamps are not at all common. The risks of fire from the use of petroleum are due, for the most part, to other causes, and can be avoided by the observance of proper care. Lamps should be filled over a metal tray, to prevent the oil from saturating the floor and other woodwork, which, in this condition, may lead to a fire. The filling and trimming of lamps should be done in the daytime, and overfilling should always be carefully avoided.

### **Improvement in the Construction of Lamps.**

A great improvement has been made in the construction of lamps within recent years, by which a more perfect combustion of the oil is secured, and a greater illuminating effect obtained. The "duplex" burner and the petroleum Argand burner are examples of the improved class of burners which yield these results. The "Empress" lamp burns oil without a chimney. It gives a pleasing light, but is said to consume a large amount of oil in proportion to the light given, and it is therefore wasteful, and unnecessarily contaminates the air.

### **Lighting by Candles.**

The use of candles for general illuminating purposes has been almost entirely superseded by gas and petroleum, and it is now very seldom that this mode of lighting is resorted to when a brilliant effect is desired. The use of a candle or two has so slight a deteriorating effect upon the air that it is hardly necessary to take them into account in estimating the amount of air required for ventilation.

### **Comparative Cost of the Different Modes of Lighting.**

The comparative cost of gas, petroleum, and candles as illuminating agents is a matter of some interest. It has been found by experiment, that the cost of gas and petroleum does not materially differ when the same illuminating effect is obtained. The cost of obtaining the same amount of light by burning sperm candles is excessive in comparison.



But an important fact should not be lost sight of; namely, that when petroleum or candles are used, people are content with a much less amount of light, and therefore the actual expenditure for this mode of lighting is generally much less than when gas is used.

**Comparison of the Effects of Combustion of Ordinary Lights.**

As regards the effects of combustion of lights upon ventilation, experiments have been made to determine the relative quantity of carbonic acid generated by different agents in producing uniform illumination. According to Douglas Galton, several kinds of lights were burned in given quantities of air, and the times at which the flames went out were carefully noted with the following effect:

|                                |             |
|--------------------------------|-------------|
| Colza oil . . . . .            | 71 minutes. |
| Tallow . . . . .               | 75 "        |
| Wax candles . . . . .          | 79 "        |
| Spermaceti candles . . . . .   | 83 "        |
| 13-Candle coal gas . . . . .   | 98 "        |
| 23-Candle cannel gas . . . . . | 152 "       |

It would appear from the above experiment, that coal gas required a longer time to vitiate the atmosphere of a room than any form of candles, or colza oil, which is an oil expressed from rape-seed combined with other vegetable oils. According to Roth and Lex, petroleum produces a less quantity of carbonic acid than gas, the amount of light being equal. It must be taken into consideration that when candles and oil are used, a less illuminating effect is satisfactory, and therefore, in practice, the contamination of the air by these agents seldom ever reaches that produced by burning coal gas. When petroleum is burned in large quantity, there is, of course, the same necessity for providing a means of escape for the products of combustion as exists in the case of coal-gas illumination.

**Lights for Reading and other Close Work.**

For writing or reading or other close work, it is important that the light should be of sufficient quantity, steady, and uniform, and so arranged that it shall come from a little above the eyes and from one side. For writing, it is usually arranged a little above the left front of the writer. When two lamps are used, they may be placed one on each side of the worker, so that the light shall come from above the level of the eyes.

**Special Outlets for the Products of Combustion.**

Until the electric light shall have been perfectly adapted for use in the household, gas-light will remain the most satisfactory means of illumination, though petroleum will undoubtedly hold a prominent place, on the score of economy and efficiency. With the moderate use of any of these

illuminants, there need usually exist no necessity for special outlets for removing the products of combustion, if the ordinary means of ventilation are properly applied. But where a large number of lights are required and are habitually employed, special provision should always be made for the escape of the resultants of combustion by some one of the methods already described, and, preferably, such as will also afford channels of escape for the vitiated air of the room.

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## CHAPTER IV.

### WATER-SUPPLY.

WATER being a prime necessity of life, and the great universal diluent and most effective agent for cleanliness, its supply of good quality and in liberal quantity is an object of the highest importance to the comfort and health of man. An insufficient quantity leads to impurities of all kinds, and an impure quality is a potent cause of disease. It has been found out by experience that a community will be unhealthy in proportion as the supply of water is scanty and the quality impure, other things, of course, being equal.

Most waters, in their natural condition, are wholesome; some contain mineral or organic ingredients, which, from their nature or their presence in excessive quantities, render the water hurtful. Waters rendered impure by the act of man are of a more dangerous character, especially when the impurity consists of waste materials from dwellings and manufactories, or the sewage of towns and cities. Excremental matters are the most dangerous impurity, as they may contain the morbid agents of specific diseases; and, therefore, all water known to be contaminated by such matters, must be regarded as suspicious, and, as a rule, incapable of purification by any artificial means. River-water is said to become purified in its flow by oxidation, subsidence, and dilution; but this process of natural purification can only be trusted in exceptional cases. It is always the wisest plan to prevent contamination of a water-supply, rather than to allow it to become polluted and then trust to our limited means of purification to restore its natural condition of wholesomeness. A water contaminated by animal impurities, especially of a fecal character,

should be avoided altogether. The general subject of water-supply may be conveniently studied under the following heads: Quantity of water required per head; sources of water-supply; qualities of water; collection, storage, and distribution of water; sources of pollution; purification of water; effects of an insufficient or impure supply on health, and the sanitary examination of water.

### Quantity of Water Required for Domestic Purposes.

The quantity of water required for each person, per day, varies according to circumstances; and it is, therefore, difficult to accurately fix the amount. For important reasons, it is necessary to decide upon an average amount which shall be sufficient for all reasonable purposes; and in determining this quantity, it is advisable that the allowance be a liberal one, as a too-rigid economy has a tendency to foster habits of personal and domestic uncleanness.

Some persons use an extremely small amount of water, from the difficulty in obtaining it or the inconvenience of getting rid of it; others, again, are accustomed to a most lavish, and even wasteful use of water. The amount will vary greatly, according to the circumstances in which people live. The proportional amount will be much greater in cities than in rural districts; and the allowance necessary in places where the water-carriage system has been adopted, and where trades and manufactures exist, will far exceed that required in places where these special demands do not occur. Allowance must also be made for a certain amount of waste, which will inevitably occur wherever water is supplied by a public system of works. All these points must be taken into consideration in estimating the standard necessary for a community.

Water is necessary for a great variety of purposes. It may be required for drinking; for cooking food and making beverages; for washing utensils, clothes, and habitations; for personal cleanliness; for removal of sewage; for industrial purposes; for cleansing public places, laying dust, and so forth; for extinguishing fires; for fountains and baths; for animals employed by man; and for irrigation of gardens, lawns, and so forth.

The amount required for domestic purposes, *i. e.*, for drinking, cooking, washing the person, the clothes, the house utensils, and the house, is variously estimated; but the most commonly accepted opinion is, that the least amount that may be safely provided is twelve gallons daily per head; and this does not include the use of water for general baths, nor for water-closets. If five gallons additional for the bath, five gallons for the water-closet, and three for unavoidable waste, flushing closets, and so forth, be provided, the total amount required per head daily, for all domestic purposes, will reach twenty-five gallons.



It is estimated that a healthy adult requires about *half an ounce* of water, daily, for every pound of weight of the body, or about from seventy to one hundred ounces, daily, for the wants of nutrition. About one-third of this amount is contained in the so-called solid food, and the remaining two-thirds are either taken as water itself, or in the form of beverages, such as tea, coffee, and so forth. The quantity fixed as an average, is, of course, subject to wide fluctuations. It will vary according to age, sex, weight, climate, and occupation. Children and females will drink less than adult males. During hot weather, and intense muscular action, the consumption of liquids will be greatly increased.

The amount required for cooking purposes, which is only in part consumed in the food, is estimated at from one-half a gallon to one gallon daily. For cleansing dishes, cooking utensils, and so forth, another gallon will be required. For the various purposes of house-cleaning, not less than two gallons of water are needed. The share of water necessary for both these purposes may be placed, in round numbers, at three gallons a day. When the clothes are washed in the house, not less than three gallons will be required, as a minimum allowance. The quantity of water deemed necessary for personal cleanliness, will depend very much upon the habits of the individual. If it be supposed that each person will take a daily sponge-bath,—which will require, each time, about three gallons of water,—an additional allowance of not less than five gallons should be made for ablution. For a general bath, another five gallons will be needed.

The above figures are based upon the results of a careful inquiry made by Dr. Parkes into the actual amount used by “a man in the middle class, who may be taken as a fair type of a cleanly man belonging to a fairly clean household.” The following is Dr. Parke’s summary :

|                                                                                    | Gallons, daily, per one person. |
|------------------------------------------------------------------------------------|---------------------------------|
| Cooking, . . . . .                                                                 | .75                             |
| Fluids as drink (water, tea, coffee), . . . . .                                    | .33                             |
| Ablution, including a daily sponge-bath, which took $2\frac{1}{2}$ to 3 gallons, . | 5.00                            |
| Share of utensil and house-washing, . . . . .                                      | 3.00                            |
| Share of clothes (laundry) washing, estimated, . . . . .                           | 3.00                            |
|                                                                                    | <hr/> 12.08                     |

A very much less quantity than twelve gallons per day is frequently made to suffice. In the poorer districts of the city, and in the homes of the indigent class in the country, on account of indifference to personal and domestic cleanliness, or of a scarcity of supply of water, the amount, in many instances, does not exceed three or four gallons a day, per head; but this average is greatly insufficient for a fairly cleanly household.

In this country, the general bath is very commonly used. No house is considered complete without its bath-room. In even the smaller houses, in towns where a public water-supply has been introduced, especially

those of recent construction, it is not at all uncommon to find that provision has been made for the general bath. This circumstance may, in part, account for the more liberal use of water in American cities than in European cities, where the general bath is not so commonly used.

A shower-bath will take from three to six gallons of water, and a plunge-bath from thirty to forty gallons; many baths require from fifty to sixty gallons. If a plunge-bath be taken only once a week, an allowance of five or six gallons per head must be added to the daily consumption.

It is highly important that an ample allowance be made for flushing the water-closet, as without it the fixtures and soil-pipe cannot be kept perfectly clean. The precise amount required for this purpose cannot be accurately determined, as some closets will require more water than others to keep them in good order. The amount generally estimated for this purpose is from four to six gallons per head. There is no doubt that an immense quantity of water is wasted by these contrivances, through the habit of so fixing the valve that a continuous stream of water will flow down the soil-pipe. The object is a good one, but it could be much better accomplished, and without waste, by using a flushing cistern with an outlet capable of quickly discharging a large body of water into the basin and soil-pipe. Water-waste preventers have been advised, but it is doubtful if this restriction should be insisted on.

For extra supply to water-closets, and for other unavoidable waste, it is customary to make an allowance of three gallons daily per head.

#### Quantity of Water Required for Municipal and Trade Purposes.

For municipal purposes, an additional five gallons will be required in order to provide for fountains, street-sprinkling, flushing sewers, extinguishing fires, and for the wants of animals, and so forth. For manufacturing and mechanical purposes, at least as much more will be required, though the amount for these objects will vary greatly. The daily allowance required for all purposes may be summed up briefly as follows:

|                                                      | Gallons per head of population, |
|------------------------------------------------------|---------------------------------|
| Domestic supply (without baths or closets) . . . . . | 12                              |
| General baths, allowing one weekly . . . . .         | 5                               |
| Water-closets . . . . .                              | 5                               |
| Unavoidable waste . . . . .                          | 3                               |
| Total house supply . . . . .                         | 25                              |
| Municipal purposes . . . . .                         | 5                               |
| Total in non-manufacturing towns . . . . .           | 30                              |
| Trade and factory purposes . . . . .                 | 5                               |
| Total in manufacturing towns . . . . .               | 35                              |

It will be interesting to compare these quantities, which represent a sufficient supply for all reasonable purposes, with the amounts actually

supplied to the principal European and American cities. The information contained in the following tables is taken from Nichols' *Water-Supply* :

## CONSUMPTION OF WATER IN EUROPEAN CITIES.

| Cities (1880).       | Daily average supply<br>per head, in |         | Cities (1877).          | Daily average supply<br>per head, in |         |
|----------------------|--------------------------------------|---------|-------------------------|--------------------------------------|---------|
|                      | U.S. galls.                          | Litres. |                         | U.S. galls.                          | Litres. |
| Glasgow . . . . .    | 60                                   | 227     | Karlsruhe . . . . .     | 154                                  | 581     |
| Paris . . . . .      | 50.2                                 | 190     | Bonn . . . . .          | 76                                   | 289     |
| Edinburgh . . . . .  | 48                                   | 181     | Hamburg . . . . .       | 63                                   | 237     |
| Dublin . . . . .     | 45.6                                 | 172     | Dresden . . . . .       | 60                                   | 228     |
| Hull . . . . .       | 39.2                                 | 148     | Frankfurt-on-M. . . . . | 59                                   | 223     |
| Birmingham . . . . . | 30                                   | 113     | Cöln . . . . .          | 53                                   | 200     |
| Blackburn . . . . .  | 30                                   | 113     | Altenburg . . . . .     | 43                                   | 163     |
| Leeds . . . . .      | 27.9                                 | 107     | Braunschweig . . . . .  | 41                                   | 154     |
| Liverpool . . . . .  | 27                                   | 104     | Bamberg . . . . .       | 39                                   | 148     |
| Manchester . . . . . | 24                                   | 91      | Kassel . . . . .        | 33                                   | 124     |
| Sheffield . . . . .  | 21.6                                 | 82      | Hanover . . . . .       | 31                                   | 116     |
|                      |                                      |         | Altona . . . . .        | 31                                   | 116     |
|                      |                                      |         | Leipzig . . . . .       | 23                                   | 86      |

It will be noticed, that, in more than half the cities mentioned in the table, the consumption of water per head of population exceeds—in some cases very greatly—the amount deemed sufficient for all domestic and public purposes; in some few cases, the amount consumed falls below the total daily amount considered ample for all purposes. The following table shows the actual consumption of water in a number of American cities:

## CONSUMPTION OF WATER IN AMERICAN CITIES.

| American cities.       | Year. | Population. | Average daily<br>consumption,<br>Gallons. | Gallons per<br>head per<br>day. | Litres per<br>head per<br>day. |
|------------------------|-------|-------------|-------------------------------------------|---------------------------------|--------------------------------|
| Fall River . . . . .   | 1881  | 49,430      | 1,448,247                                 | 30.1                            | 114                            |
| Providence . . . . .   | 1881  | 102,500     | 3,716,937                                 | 36.3                            | 137                            |
| Lowell . . . . .       | 1880  | 59,485      | 2,252,197                                 | 37.9                            | 143                            |
| Cambridge . . . . .    | 1881  | 52,880      | 2,472,108                                 | 46.7                            | 177                            |
| Brooklyn . . . . .     | 1880  | 566,689     | 30,744,590                                | 54.2                            | 205                            |
| Philadelphia . . . . . | 1880  | 847,542     | 57,707,082                                | 68.1                            | 257                            |
| St. Louis . . . . .    | 1879  | 346,000     | 24,958,000                                | 72.1                            | 273                            |
| Cincinnati . . . . .   | 1880  | 256,708     | 19,476,739                                | 75.9                            | 287                            |
| New York . . . . .     | 1880  | 1,206,590   | 95,000,000                                | 78.7                            | 297                            |
| Boston . . . . .       | 1881  | 416,000     | 38,214,900                                | 92.                             | 348                            |
| Chicago . . . . .      | 1880  | 503,304     | 57,384,376                                | 114.                            | 431                            |
| Detroit . . . . .      | 1881  | 118,000     | 17,926,377                                | 151.9                           | 574                            |

From the above tables, it will be seen that there is a great difference in the quantity actually supplied in different places; and that, in most of the cities named, the amount consumed is far above that estimated as being adequate for all uses. If the standard selected be a correct one, it must be inferred that the excessive consumption of water is due to waste; and this view is substantiated by the opinion of experts, who assert, upon



reliable evidence, that from one-quarter to one-half of the water furnished is wasted. In confirmation of this opinion, we may refer to the results of the waste-water inspection which was carried on for a limited period in the cities of Glasgow and Boston. Before the inspection in Glasgow, the consumption of water per head per day was 55.8 gallons; and after the first three inspections, it was reduced to 38.4 gallons. In Boston, before the inspection, the quantity consumed was 58.5 gallons; and after inspection, 37.7 gallons. By these examinations, leakages from pipes and from imperfect fixtures, and unlawful and unnecessary and wasteful use of the water, were detected and the average daily consumption reduced to a figure which corresponds more nearly with the standard deemed adequate for the demands of a large community.

### Water-waste and its Prevention.

Two plans have been suggested for preventing waste of water. The one is by a rigid system of inspection; the other, by the compulsory introduction of the water-meter. Of the latter plan it may be said, that it does not meet with popular approval. People who have become accustomed to the liberal use of water, object to having it doled out to them by measure, although they are not expected to pay for more than is used. The British Parliament, so late as 1884, refused to permit the water companies to sell water by meter. This action is significant, and is probably based upon the assumption that the introduction of this system would cause a restricted use of water; and, therefore, would work injury to the public health. All that is desired to be accomplished might be brought about by a system of inspections aided by the use of the water-phone, by warnings, and by the imposition of a fine in cases of reckless waste of water. Bearing in mind the fact that the free use of water is now more than ever indispensable to the health and comfort of the people, it is difficult to see how any rigid restrictions upon its consumption, even for the laudable purpose of preventing waste, can be at all advantageous, except in the relatively insignificant particular of a slight reduction in the water rates.

### Sources of Water.

Rain is the source whence all supplies of water are originally derived. When it falls to the earth, a small proportion of it is immediately evaporated into the air; part of it flows over the surface of the ground until it reaches the nearest stream or body of water, where it is collected on its passage to the sea; another portion penetrates the surface and collects in the soil to supply springs and wells, and eventually commingling with the surface-water, accumulates in lakes or finds its way into streams and rivers, and thence to the sea; and the remainder is utilized by vegetation and the chemical processes that are constantly taking place in the soil.

### Rain-water as a Source of Supply.

Rain-water, in its passage through the air, becomes highly aerated, the proportion of oxygen which it contains being in excess of that in atmospheric air. If carefully collected in the open country, it is the purest natural water obtainable, and is pleasant and wholesome; but it is far from being pure in a chemical sense. In its descent, it washes from the air gaseous and solid impurities, which are particularly noticeable in the water collected in the neighborhood of inhabited places. These impurities are commonly carbonic acid, ammoniacal salts, small amounts of nitrous and nitric acids, organic matter, and suspended particles, such as dust, microscopic plants, and so forth. In towns where coal is freely burned, it may contain sulphurous and sulphuric acids, and even sulphuretted hydrogen. In places bordering upon the sea, common salt is one of its ingredients. When rain is collected from the roofs of houses, the water may also contain particles of soot, excrement of birds, dead leaves, dust, and various other impurities, which are washed into the cistern by the first fall of the rain. To guard against the possibility of this occurrence, an automatic arrangement has been invented for turning to waste the first part of the rain-fall, which will contain most of the impurities collected from the house-top.

An accidental source of pollution is possible through the carelessness or ignorance of servants, who may seriously impair the quality of the water by emptying house-slops into the roof-gutters, from which it will be conducted into the cistern. The possibility of such an occurrence should always be borne in mind.

On account of its softness, due to the absence of certain salts of lime and magnesia, rain-water is peculiarly adapted for use in washing and in cooking. Its high degree of aëration, and its purity (when reasonable care is observed in its collection), makes it a pleasant and healthy beverage. Rain-water may be very advantageously used in places where the spring- or well-water is bad on account of the natural character of the soil, or on account of accidental impurities, that in some unaccountable way gain access to it. The uncertainty of the supply is, however, a disadvantage which should not be overlooked, and which may necessitate considerable expense in the provision of large reservoirs.

### Ice- and Snow-water.

Snow-water and water from melted ice are both used for drinking purposes; the latter very extensively in the United States. By the process of freezing, water becomes non-aerated, and is more or less purified by the exclusion, to a large extent, of foreign substances, especially the salts, contained in it. It must not, however, be supposed that this purification is complete; for ice taken from a body of water containing

organic impurities, and therefore not fit for a water-supply, will always contain more or less of this objectionable matter.

Snow-water contains small amounts of carbonic acid and air, and the usual salts of rain-water; though the amount of ammonia is generally less. Snow-water is generally considered unwholesome. This is undoubtedly the case when the water is obtained from snow near dwellings, where it is liable to contamination from impurities deposited on the ground. When collected in the usual way, along with rain-water, it may be considered as wholesome as rain-water.

### Spring-, Well-, and River-waters.

The water derived from springs, wells, rivers, and lakes, varies greatly in its quality and composition, according to the nature of the soil and geological formations through which it has passed, and the character of the stratum upon which it rests, or of the channel through which it flows. In passing into the ground, the water absorbs a large proportion of carbonic acid, which exists in the soil in much larger proportion than in the atmosphere. As it settles deeper into the ground, it dissolves and decomposes, with the aid of the carbonic acid thus absorbed, various constituents of the soil which it meets with, and often becomes so highly charged with mineral substances as to be unsuitable for ordinary use.

The substances taken up by rain-water in its progress underground, may be suspended matters, mineral, vegetable or animal; dissolved gases, such as nitrogen, oxygen, carbonic acid, and occasionally some other gases; and dissolved solid matters, such as lime, magnesia, soda, potassa, iron, and other substances, combined with different acids. Certain metals may also be contained in it. Some formations, as the primitive and metamorphic rocks (granite, gneiss, trap-rock, and so forth), contain but small quantities of soluble matter, and therefore the water from them is generally very pure. The waters from clay-slate, and from millstone grit and hard oölite are also very pure. Loose sands and gravels, and soft sand-rock, and some clay formations, yield waters which differ very much in composition, some of them being very pure; others, again, containing large amounts of organic matter and other impurities. The chalk-waters are clear, sparkling, and wholesome. They hold in solution a considerable amount of carbonate of calcium, and smaller quantities of other salts, are highly charged with carbonic acid, and contain, as a rule, only a small quantity of organic matter. These waters are hard, but improve by boiling.

Waters derived from limestone strata are clear, sparkling, and palatable; but they are not so wholesome as the chalk-waters. They usually contain more sulphate of calcium (plaster of Paris), and less carbonate of calcium, than the chalk-waters; and, when derived from the magnesian limestone formations, contain much carbonate and sulphate of magnesium, which are



objectionable constituents. Organic matter is not present in any considerable quantity. These waters are hard, and do not soften much on boiling, and are therefore not suitable for cooking and washing purposes.

#### **Surface-waters, and Waters from Alluvial Soils, from Marshes, Etc.**

Surface-waters, and waters from alluvial soils, from marshes and from lands in a high state of cultivation, are generally very impure on account of the presence of organic matter, which is often of a dangerous quality. Yet there are some marshes that yield a good water, such as the Dismal Swamp, on the borders of Virginia and North Carolina, and the Red Cedar Swamps on the coast of New Jersey.

#### **Conditions Influencing the Temperature and Quality of Water.**

The quality of water, wherever obtained, is influenced more by the composition of the strata through which it passes than by the depth of the spring. Water drawn from a great depth, or from near the surface, may be either pure or impure. The depth of a spring influences the temperature of the water. The temperature of water in shallow springs varies with the temperature of the atmosphere; but when the water is taken from a moderate depth, it generally maintains the average temperature of the locality for the year. The temperature of the Yellow Springs, in Pennsylvania, is about 52° F., which is about the mean temperature of Philadelphia for a term of years. Springs having a great depth are warm, or even hot, as some Artesian wells, and the geysers of Iceland and of Montana and California.

#### **Spring-water.**

Spring-water is generally considered wholesome, and is very commonly depended on in the country for ordinary purposes, though rain-water is frequently made use of for cooking and for washing, especially if the spring-water is hard. Springs are due to the effort of water to seek its own level, the movement of the water being due to the pressure of water at a higher elevation; or, they may be due to the pressure of gases developed in the deep recesses of the earth, as in the case of mineral springs. Although spring-water, especially when drawn from deep sources, is usually considered wholesome, the fact that it is spring-water should not be taken as a guarantee of its purity, since dangerous impurities may often gain access to very deep springs. There is this advantage, however, that the deeper the spring, the better the chances for filtration, and the less the liability of contamination from accidental sources.

#### **Well-water.**

Well-water resembles spring-water in many respects; but it is not always identical with it. It has not the free and constant flow of the water supplied by springs, and is, therefore, more exposed to the dangers

of contamination when retained in the well itself. This is especially the case in shallow wells.

Water obtained from shallow wells, from deep wells, and from the so-called Artesian wells, varies greatly in its composition.

### Shallow Wells.

Shallow wells, as the name implies, are such wells as draw their supply of water from no great depth, never more than fifty feet, and most commonly from a depth not exceeding twenty or thirty feet. Shallow wells draw their supply of water from the ground-water, which is supplied by the local rain-fall penetrating the soil until it reaches an impervious stratum; or, from the general ground-water, which, at variable depths beneath the surface, is constantly in motion towards the nearest water-course or body of water. In either case, the well will drain the soil around it for a greater or less distance, and the water which it contains, especially under the conditions first mentioned, is in danger of being contaminated by impurities at, or near, the surface of the ground. In inhabited places, this danger is most imminent. For these reasons, surface-, or shallow-well waters, though sometimes comparatively pure, are always regarded with suspicion.

### Deep Wells.

Deep wells are such as draw their supply of water from a depth of fifty feet or more. The quality of water supplied from this source is usually considered good, though much depends on the character of the strata in and upon which the well is sunk. The water is generally obtained from pervious, water-bearing strata, lying beneath one or more impermeable layers of hard clay or rock. This provision will, in most cases, afford ample protection against local sources of contamination.

### Artesian Wells.

Artesian wells are essentially of this character. They are made by boring into the ground to a great depth, until a layer of water is reached, which is retained beneath an impervious stratum under pressure. When this stratum is penetrated, the water rises through the borings towards the surface of the ground. As might be expected, water derived from the great depth of such wells is free from organic impurities resulting from animal and vegetable decay. It is, however, generally warm and poorly aerated; and, in some cases, contains an excess of mineral matter. The theory of the Artesian well is explained by Fig. 111. The water-bearing stratum is represented at *aa*, and the extremity of the tube, where it reaches the stratum of water, at *b*. The water is observed to pass through the tube toward the surface of the ground, which is below a higher level of the water, at *aa*.

### River-water.

The water of rivers and streams is one of the most common sources of supply. On account of its copiousness and the facility of obtaining it, large cities and towns are in the habit of depending on it for their daily supply.

River-water, being derived from a variety of sources, varies very much in its composition. It is softer, in most cases, than either spring- or well-water, and contains a less amount of mineral salts, but is often contaminated with solid and liquid refuse matters of various kinds. The most obnoxious impurity of streams and rivers is organic matter in the form of sewage, which is discharged into the water from towns and cities. It is said that water tends to purify itself on flowing a distance of several miles by the constant agitation to which it is subjected, which facilitates oxidation of the impurities, and that this process is still further aided by the action of fresh-water plants. There can be no doubt that the passage of water over natural water-falls or artificial dams, or over a rocky bed, tends to its improvement by aëration; but no great value should be placed on this process of purification of water known to be seriously polluted. The only safe course is to prevent the pollution, or to abandon the supply altogether.

### Lake-water.

Lake-water is generally a soft water, as it contains but a small amount of mineral matter. It is liable to contamination from the washings of the surrounding country, which contain a greater or less amount of organic matter. The great lakes of North America furnish a supply of good water, provided it is taken from a sufficient distance from the shore to escape the polluting effects of sewage which, unfortunately, is deposited in it. The pollution of the lake-water in the vicinity of Chicago, Cleveland, and Milwaukee, has already become a serious matter which, sooner or later, will compel a modification in the plan of disposal of the sewage of those cities, or the abandonment of this source of water-supply.

### Distilled Water.

Distilled water is sometimes used for drinking and cooking purposes. It is not uncommon at sea to resort to distillation as a means of procuring a supply of potable water. It might be supposed that water which has been deprived of its solid ingredients by distillation, would be a most desirable and wholesome drink, but such is not wholly the case. As it is nearly free from air, it is unpalatable; and, by some, is considered unwholesome. The fact is, that many of the constituents in good spring- or river-water are advantageous to the human system, being similar to the constituents in healthy human blood. Distilled water may be rendered



more palatable by aëration, which can easily be accomplished by running it through a cask having the bottom pierced with fine holes. Lead poisoning has been produced on shipboard by drinking distilled water which has been prepared without due regard for the danger incident to the use of lead in the distilling apparatus.

### Quality of Water.

It is very difficult to define a wholesome water, but the general characters that such a water should possess are easily enumerated. They are perfect clearness; absence of color; freedom from odor and from taste (that is to say, neither salt nor sweet); good aëration; freedom from deposit on standing; and a moderate degree of softness. But a water may have all these characters, and yet be unfit to drink on account of the presence of dissolved matters, which it is not possible to detect, except by chemical analysis. Even chemical analysis cannot always be relied on to detect some forms of impurity, which may of themselves be sufficient to render a water unfit to drink; and, therefore, "the mere fact that chemical analysis fails to detect impurity should not be accepted as a guarantee that a water is fit to drink." With our present knowledge of water as a vehicle for the transportation of "disease-germs," those subtle poisons which are supposed to be the cause of many of the most virulent human diseases, it is evident that the greatest caution should be exercised in the use of water into which sewage from human habitations is permitted to flow, even though such a water may not have been condemned by the results of chemical examination.

### Palatableness of Water.

A water may be palatable, and, at the same time, be unwholesome. The following table, taken from the Report of the Rivers' Pollution Commissioners, will serve to illustrate this fact:

|                    |   |                                                          |   |                          |
|--------------------|---|----------------------------------------------------------|---|--------------------------|
| WHOLESOME . . .    | { | 1. Spring-water . . . . .                                | } | VERY PALATABLE.          |
|                    |   | 2. Deep well-water . . . . .                             |   |                          |
|                    |   | 3. Upland surface-water . . . .                          |   |                          |
| SUSPICIOUS . . . . | { | 4. Stored rain-water . . . . .                           | } | MODERATELY<br>PALATABLE. |
|                    |   | 5. Surface-water from cultivated<br>land . . . . .       |   |                          |
|                    |   | 6. River-water to which sewage<br>gains access . . . . . |   |                          |
| DANGEROUS . . . .  | { | 7. Shallow well-water . . . . .                          | } | PALATABLE.               |

From the above table it will be seen, that some of the most dangerous waters are, in fact, more palatable than waters which often rank among

the best supplies, as rain-water, for example. From this it must be inferred that the taste of a water is not a reliable test as to purity.

The pleasant, sparkling quality of water is due to the gases contained in it, particularly atmospheric air and carbonic acid gas. This latter gas is the one that gives to aerated waters their effervescent property. A well aerated water will deposit bubbles of gas on the sides of a glass of water, if allowed to stand for a while; the same effect is not produced by distilled water, which is nearly free from air, or by a flat water, which, in this respect, resembles distilled water. It is a significant fact, that the sparkling character of water may depend upon the presence of gases evolved by the process of organic putrefaction; and, therefore, this quality should not be relied on as a test of a good water.

It is commonly supposed, that the taste of water is due to the salts or other solid substances dissolved in it; but this is a mistaken idea, as Prof. de Chaumont has very clearly shown. He found, by experiments, that very large quantities of these substances must be present before they can be distinctly tasted; in fact, such quantities as would render the water unfit for domestic use. The only exception noted was in the case of metals, such as iron, zinc, and so forth; a very small quantity of these substances, notably of iron, being capable of imparting a distinct taste to water.

### Hardness of Water.

Water is spoken of as being hard or soft. The hardness of a water is generally due to the presence of the compounds of lime or magnesia. Hard water gives a peculiar sensation of roughness when the fingers are moistened with it and rubbed together, and it does not easily make lather with soap. Soft water feels smooth to the touch, and readily dissolves soap. If ordinary soap be added to hard water, the mineral salts in the water decompose the soap, and form insoluble compounds, which give to the water its curdy appearance. After these compounds of lime or magnesia have been completely converted into insoluble lime or magnesia soap, any additional soap will dissolve in the water and form a lather, and will thus be available for washing. Hard water is, therefore, enormously wasteful of soap, and is inconvenient for washing purposes on account of the formation of curd. Another objection, of great importance in manufacturing towns, is the formation of scales in steam boilers in which the water is used.

### Temporary and Permanent Hardness.

Hardness is of two kinds, temporary and permanent. The former is due to the presence of carbonate of lime or magnesia kept in solution by the aid of the carbonic acid in the water. The latter is usually

caused by the sulphates of lime and magnesia, the sulphate of lime (gypsum) being the most common.

The simplest way of removing temporary hardness is by boiling the water. This drives off the carbonic acid that has kept the carbonate of lime in solution as a bicarbonate, and the carbonate of lime is then thrown down as a deposit. Another method is by adding common washing soda (carbonate of soda), which combines with the carbonic acid holding the carbonate of lime in solution, and forms a bicarbonate of soda (which is soluble in water), and releases the carbonate of lime, which, being insoluble, is deposited as a fine powder. Still another method consists in the addition of lime-water, which combines with the excess of carbonic acid, and causes the carbonate of lime to deposit as a sediment. The advantage of this latter process is its great economy, and it is for this reason preferable to the other methods that involve the use of chemicals. Hardness of a water may be overcome by the use of plenty of soap; but the plan is an expensive one.

#### **Beneficial Effects of Boiling Water.**

As already remarked, boiling reduces the hardness of water; it also helps to deprive it of other forms of impurity. It is a good plan to boil water whenever there is any suspicion of impurity. The flatness may be relieved by pouring the water from a height from one vessel into another; and an agreeable temperature may be obtained by the use of ice. Hard water is very undesirable for cooking purposes, especially for making tea and cooking vegetables.

#### **Very Hard Waters Undesirable for Either Drinking or General Domestic Purposes.**

Very hard waters are considered undesirable, either for drinking purposes or for domestic purposes generally. Moderately hard waters, on the other hand, are regarded as being quite as wholesome as soft waters, for drinking purposes. Some writers hold that the salts of lime and magnesia in hard waters are useful in aiding the nutrition of the body; but this point is disputed, and, apparently, upon good evidence. Hard waters are supposed to irritate the stomach, and when they contain an excess of calcium and magnesium sulphates, may cause irritation of the bowels and produce diarrhoea in persons accustomed to soft waters. Gravel and stone in the bladder have been attributed to the use of hard water; and so also have swellings of the glands of the neck, as goitre, for example, when the hardness is due to the presence of magnesia salts.

Soft water, obtained in a locality free from all sources of contamination, is unobjectionable; but it frequently happens that soft waters are unwholesome on account of the impurities that gain access to them at



the points where they are collected. The following classification of waters, according to softness, is given by the Rivers' Pollution Commissioners in their Sixth Report:

1. Rain-water.
2. Upland surface-water.
3. Surface-water from cultivated land.
4. Polluted river-water.
5. Spring-water.
6. Deep-well water.
7. Shallow-well water.

#### **Salts that Do Not Produce Hardness in Water.**

Certain salts, such as chloride of sodium (common salt), chloride of potassium, chloride of ammonium, and the carbonates of sodium and potassium, may be present in water without imparting to it the quality of hardness. Of these substances, the chloride of sodium and the carbonate of sodium are most commonly met with; the former being a constituent of nearly all waters. When common salt is present in excess, so as to give a decided taste, the water is said to be brackish, and is not suitable for drinking purposes, though it is sometimes used with, apparently, no ill consequences. It is particularly unsuitable for children and invalids, and in all cases of derangement of the digestive organs. Sea-water is not fit to drink; it will not allay thirst, but produces nausea and distress.

#### **Color and Turbidity.**

The best waters are clear and free from color, or have only a faint, bluish tint when looked at through a depth of two or three feet. Yet turbidity does not necessarily affect the wholesomeness of a water. The opacity may be due entirely to suspended mineral matters, such as fine particles of clay, sand, and so forth, which are so frequently present in river-water, particularly after hard rains. These particles, being of greater specific gravity than the water itself, soon settle out if the water be allowed to stand. The waters of many of the rivers of the United States are regularly muddy, or at times of freshets, and sedimentation becomes a necessity, not only for the sake of improving its appearance, but also its quality; for the particles of gritty matter contained in turbid water often provoke diarrhœa, especially in persons not habituated to its use. The characteristic muddy appearance of the Mississippi is due to suspended mineral matter, which may be gotten rid of by settling, except at seasons of freshets, when the water contains a large amount of very fine sediment, that is not easily removed by standing.

The mere fact of a water being turbid does not necessarily class it as unwholesome. But it very frequently happens that such a water also

contains a large amount of organic matter, which may, or may not, seriously impair its fitness for drinking purposes, according to the character of this matter. Vegetable impurity is not necessarily injurious; but the presence of animal matter, on the other hand, is almost invariably hurtful.

The water of streams and rivers is often discolored by the drainage of manufactories, which may, or may not, seriously affect the quality of the water, according to the character and amount of the discharge. It may, however, be generally assumed that where this kind of matter is permitted to flow into a stream, advantage will be taken of this convenient mode of disposal for getting rid of the sewage also.

### Animal and Vegetable Life Found in Water.

A great variety of living organisms are found in water, some of them being very common. The true meaning of the presence of these minute forms of life has not yet been satisfactorily determined. They are not supposed to be in themselves hurtful, but their presence in water, in some particular forms, has been thought to indicate the existence of putrifying substances. The forms included in the family of the *bacteriaceæ*, namely, *micrococcus*, *bacteria*, *vibrio*, and *spirillum*; the *rhizopoda*, especially the *amæbæ*; certain forms of *infusoria*, and *fungi*, are supposed to indicate the presence of putrifying substances. *Algae* and *diatoms* are found in almost all running water, and the former are also seen in many well-waters. Their presence in water is not sufficient to condemn it, since they are not held to be significant of any great degree of impurity. Small worms, as the common *anguillula*, generally indicate impurity, and water in which they exist should, at least, be viewed with suspicion.

The *rotifera*, or wheel-animalculæ, are very common, and are not generally considered of much importance; but their occurrence shows the presence of impurity, though it may not be harmful.

The *entomostraca*, or water-fleas, such as the *Daphnia pulex* and the *Cyclops quadricornis*, frequently found in water, especially in the spring of the year, are not considered as indicating any dangerous impurity; on the contrary, Mr. Macadam has advanced the opinion that the presence of these forms of animal life is a proof of the purity of a water, as they are not found in bad water, in which, it is said, they cannot live.

### Dead Animal and Vegetable Matters.

Dead animal and vegetable matters are also frequently met with in drinking-water. Dead vegetable matter in the form of bits of leaves, portions of wood, or amorphous masses of decayed vegetable tissue, cotton and linen filaments, starch granules, and threads of the tissue of vegetables used by man, are often detected in water, and are of value as pointing to the source of contamination.

Various kinds of dead animal matter are also met with, such as epithelial scales of man, human hair, the hairs of domestic animals, wool, fibres of silk, the scales, legs, and wings of insects, and so forth. The presence of these substances shows that there has been communication with the habitations of men, and is presumptive evidence of the impurity of the water, or, at least, of its suspicious character.

The following, in abridged form, is the classification of drinking-water given in Parkes' *Hygiene*:

| 1. PURE AND WHOLE-SOME WATER.                                                                                                                                                         | 2. USABLE WATER.                                                                                                                                                                   | 3. SUSPICIOUS WATER.                                                                                                                                                                                               | 4. IMPURE WATER.                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Transparent, sparkling, and well-aërated. No suspended matter; palatable; no color; no smell. Mineral matter; vegetable forms with endochrome; large animal forms; no organic débris. | Transparent, sparkling, and well-aërated; no suspended matter, or easily separable; colorless, or slightly green; no smell; palatable. Mineral matter, etc., the same as in No. 1. | Turbid; considerable suspended matter; yellowish color; marked taste; no smell; vegetable and animal forms more or less pale and colorless; organic débris; fibres of clothing, or other evidence of house-refuse. | Turbid, and not easily purified by coarse filtration; large amount of suspended matter; distinctly yellow, or any marked color; any marked taste or odor; bacteria of any kind; fungi; numerous vegetable and animal forms of low types; epithelia, or other animal structures; evidences of sewage; ova of parasites, etc. |

### Organic Matter in Water.

Organic matter constitutes a most serious impurity in water. But it is not every kind of organic matter that is considered deleterious. Organic matter may be either vegetable or animal. Vegetable matter is present, to a greater or less extent, in most waters, and is generally harmless. An exception should be made in the case of some marsh-waters, which are known to be hurtful on account of their irritating effect upon the bowels.

Animal matter, especially of fecal origin, is always a dangerous ingredient. The most frequent source of this form of impurity is sewage, which may get into drinking-water in many ways. It may be discharged directly into a stream or river, or other body of water, from the sewers of a town or city; or it may gain access to wells by soakage from leaky cess-pools or imperfect drains, or it may contaminate the supply within the house by careless arrangement of the water-cistern. Animal matter may find its way into reservoirs of drinking-water by soakage from barn-yards or from refuse matter carelessly deposited on the surface of the ground near wells, or it may be derived from the drainage of grave-yards, slaughter-houses, bone-boiling establishments, and so forth. Small animals often get into wells and cisterns where they decompose and pollute the water.



The accompanying plate, representing polluted river-water and polluted well-water, is taken from Parkes' *Hygiene*, and shows the microscopic objects found in a specimen of polluted Thames-water, and in polluted water taken from a well at Netley. The description of most of the forms and appearances of the various animal and vegetable bodies, and the extraneous substances depicted in the plates, may be obtained by a reference to the plates and table of microscopic objects found in drinking-water, which is taken from the excellent work of Dr. Fox on *Sanitary Examinations of Water, Air, and Food*.\*

### Collection, Storage, and Distribution of Water.

It is necessary, in the next place, to refer to the methods of collecting, storing, and of distributing water. Collections of water occur naturally in the form of streams and rivers, or in depressions in the ground, from which a supply is obtained, upon a large scale, by pumping into reservoirs for distribution to the inhabitants of a town by means of a system of tubing. Or, they occur in the form of vast subterranean sheets of water, from which a supply is obtained by perforating the water-bearing stratum, and allowing the water to flow to the surface spontaneously, or forcing it to the surface by pumps. Or, the water may be collected from the surrounding soil by sinking shallow wells. In a smaller number of cases, rain-water is collected from roofs, or from gathering-grounds specially prepared for the purpose. The storage takes place in cisterns upon the premises, frequently located beneath the ground.

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#### \* DESCRIPTION OF PLATE OF MICROSCOPIC OBJECTS FOUND IN DRINKING-WATER.

- |                                                               |                                                                                |
|---------------------------------------------------------------|--------------------------------------------------------------------------------|
| 1. <i>Actinophrys Sol.</i> Order, RADIOLARIA.                 | 22. <i>Tabellaria floccosa.</i> Family, DIATOM-<br>ACEÆ.                       |
| 2. <i>Algae</i> , with <i>bacteria</i> and <i>diatoms</i> .   | 23. <i>Chaetophora elegans.</i>                                                |
| 3. <i>Bacillus.</i> }                                         | 24. <i>Euglenia.</i> Class, INFUSORIA.                                         |
| 4. <i>Bacteria.</i> }                                         | 25. <i>Anguillula.</i> Order, NEMATODA.                                        |
| 5. <i>Amœba.</i> Class, RHIZOPODA.                            | 26. <i>Rotifera.</i>                                                           |
| 6. <i>Vorticellæ.</i> Class, INFUSORIA.                       | 27. <i>Cyclops Quadricornis.</i> Order, COPEPODA ;<br>Sub-class, ENTOMOSTRACA. |
| 7. <i>Ova of Entozoa.</i>                                     | 28. <i>Cosmarium Margaritiferum.</i> Family,<br>DESMIDIACEÆ.                   |
| 8. <i>Euplotes Vannus.</i> Class, INFUSORIA.                  | 29. <i>Diatoma vulgare.</i>                                                    |
| 9. <i>Paramecium.</i> Class, INFUSORIA.                       | 30. <i>Diatom.</i>                                                             |
| 10. <i>Young filaria</i> , or thread-worms.                   | 31. <i>Fungi.</i>                                                              |
| 11. <i>Confervæ.</i>                                          | 32. Vegetable cellular tissue.                                                 |
| 12. Muscular fibre.                                           | 33. <i>Scenedesmus.</i> Family, DESMIDIACEÆ.                                   |
| 13. <i>Spirillum.</i> Family, BACTERIACEÆ.                    | 34. <i>Daphnia pulex.</i> Order, CLADOCERA ;<br>Sub-class, ENTOMOSTRACA.       |
| 14. Hair (human).                                             | 35. <i>Micrococcus.</i> Family, BACTERIACEÆ.                                   |
| 15. Linen fibre.                                              | 36. <i>Infusoria.</i>                                                          |
| 16. Cotton fibre.                                             | 37. <i>Ova of Nais.</i> Class, ANNELIDA.                                       |
| 17. Mineral particles.                                        | 38. Vegetable débris.                                                          |
| 18. Fragment of deal-wood.                                    |                                                                                |
| 19. <i>Stomata of leaf.</i>                                   |                                                                                |
| 20. Epithelial scales.                                        |                                                                                |
| 21. <i>Closterium moniliformis.</i> Family, DES-<br>MIDIACEÆ. |                                                                                |
-

### Collection of Rain-water.

It is not at all practicable to collect and store a general supply of rain-water sufficient for the uses of a town or city, and yet there are places in which water thus collected is the main dependence of the inhabitants for the uses of the household. The city of Venice, for example, has long been accustomed to draw its supply from rain-water collected in filtering cisterns underground. In Holland, it is now the practice to collect rain-water on gathering-grounds of sand, and the quality of the water is said to be good, and greatly superior to that formerly obtained from canals and other sources. In some of the watering-places along the New Jersey coast, where the surface-water is dangerously polluted, rain-water is collected from the roofs of houses, and stored in cemented cisterns underground. Where reasonable care is taken with the collection and storage, the water is pure and wholesome; but the uncertainty of the supply is sometimes a serious disadvantage. In most places, a sufficient amount of rain-water can be collected to meet the wants of the household. In order to ascertain the amount of water procurable from this source, it is necessary to know the amount of rain-fall and the area of the collecting-surface.

There is no difficulty in obtaining information in regard to the average rain-fall of a district, since the establishment of the Signal Service Bureau, which has its stations distributed all over the country. The area of the receiving-surface must be obtained by measurement. In making this measurement, the error should not be committed of taking into account the entire roof-surface, which is generally more or less irregular. The area of the flat space on which the house stands, with the addition of the space covered by the projecting eaves, will give the correct area of the receiving-surface of the roof. A small house, forty feet long by twenty feet wide, would furnish an area of 800 square feet. If this be multiplied by 144 (the number of square inches in one foot), the result will be 115,200 square inches; and multiplying again by the average rain-fall, say forty-two inches (the average rain-fall of Philadelphia for a period of years), we have 4,838,400 cubic inches; this number multiplied by 231 (the number of cubic inches in a standard U. S. gallon) will give the number of gallons the roof of the house will receive in a year, namely, about 21,000 gallons, or an average through the year of nearly sixty gallons daily. If we suppose the house to be occupied by six persons, there would be enough for an allowance of ten gallons per day per head.

In making the above calculation, no allowance has been made for the waste occurring by evaporation and defective arrangements. It is estimated that not more than one-half of the rain-fall will be collected. This would reduce the quantity to about five gallons daily per head, an amount evidently insufficient for all purposes, but quite ample for cooking and drinking purposes, and with some to spare for other uses. The comple-

ment can be made up by the use of well-water, which is generally suitable enough for the commoner purposes of the household.

### **Collection of Rain-water in Tanks and Cisterns.**

Rain-water collected from the roof-surface is generally stored in a tank under the roof, or in an underground cistern, the latter plan being preferable. When the storage of water is at the top of the house, there is a liability of contamination from communication with the drains by the overflow pipes; and there is, besides, the risk of damage to the house and its contents by a leak or an overflow.

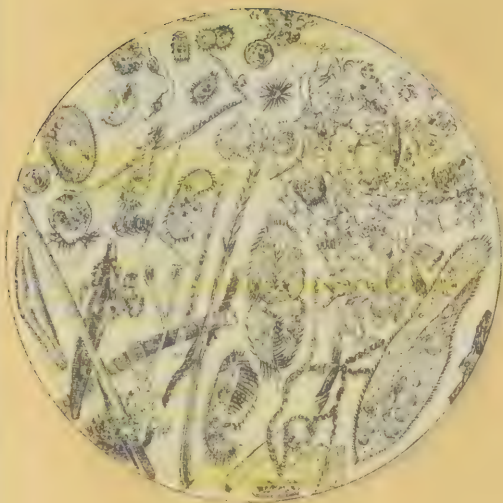
### **Construction of Tanks and Cisterns.**

The best material for cisterns is slate, properly put together with hydraulic cement. Lead or its compounds should never be used for securing the parts; nor should lead, or even zinc, be used as the material for constructing the cistern or tank, as these metals may be dissolved in sufficient amount to render the water injurious. Iron tanks are unobjectionable, if the surface is protected from contact with the water by a coating of coal-tar paint or good cement. Cisterns constructed of brick and lined with cement are very commonly used, and will answer the purpose if properly made. Concrete, artificial stone, and wood are sometimes used for the storage of water. In New Orleans, the tanks are made of cypress wood, and are usually placed above ground. Often these tanks are in close proximity to privies; and, when the enclosures are unventilated, there is a risk of the water absorbing impurity from the foul air.

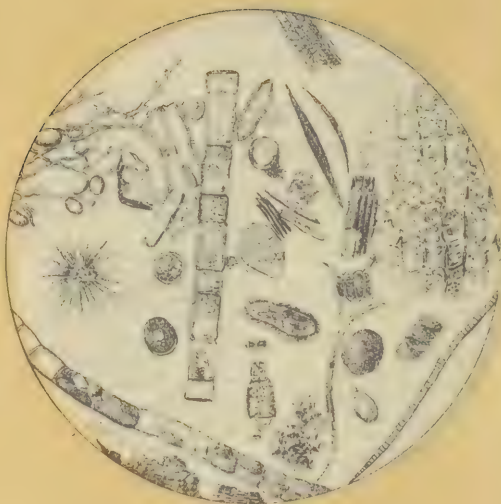
### **How to Prevent the Contamination of Rain-water.**

Cisterns should be covered to keep out small animals and other offending substances. A strong wire-cloth will make a good covering, as it will permit the access of air, while it protects against the entrance of gross impurities. When cisterns are built in cellars, it is highly important that these places should be kept in a perfect state of cleanliness, and thoroughly ventilated. The facility with which water absorbs impurities in the air should be constantly borne in mind. Inspection should be made from time to time of the interior of cisterns, in order to see that impurities are not collecting; and it is desirable that these receptacles should be cleaned out at least three or four times a year, as sediment will collect even when the greatest care is taken of the receiving-surface. If this is not done, there will be an accumulation of deposits, which being stirred up at the time of every rain-fall, will render the water disagreeable, if not unfit for use. Frequent examinations will also afford protection by discovering any leaks that may exist. A leaky condition of the cistern may lead to contamination of the water by

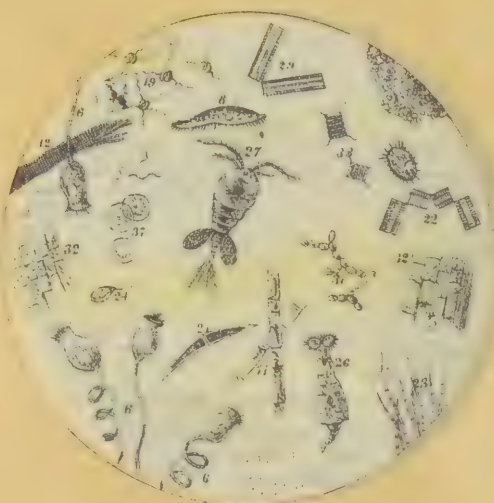
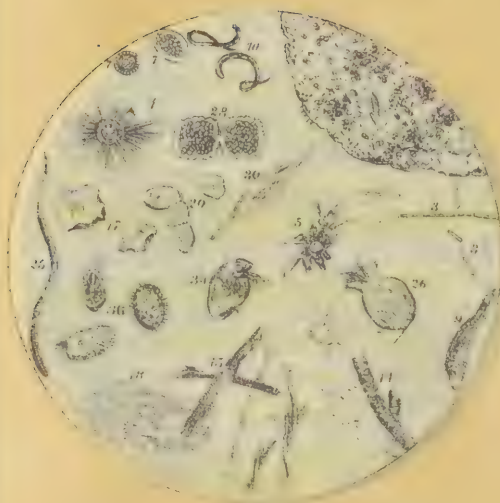




*Polluted River-Water.*



*Polluted Well Water.*



*Microscopic Objects Found in Drinking-Water.*



soakage from the soil. To show that such a condition is not infrequent, Prof. Nichols refers to the results of an examination, made by Dr. Smart, of a large number of the 4,000 cisterns said to be in use in the city of Memphis. Of the 529 cisterns examined, there were—

|                                 |     |
|---------------------------------|-----|
| Undoubtedly sound . . . . .     | 163 |
| Probably sound . . . . .        | 82  |
| Probably siping . . . . .       | 94  |
| Undoubtedly leaky . . . . .     | 190 |
| Total number examined . . . . . | 529 |

The various substances which collect on the house-roof, such as dust, soot, excrement of birds, leaves, and bits of wood, will generally be washed into the cistern by the first inflow of water. The first portions of the rain, which contain the washings of the roof, are therefore the most impure, and should be allowed to run to waste. This object is accomplished by an apparatus, simple in construction and automatic in its action, which collects and rejects the first and objectionable part of the rain-water, and allows that which follows to flow direct to the cistern.

Overflow-pipes should have no connection with soil-pipes or drains, or other avenues or depositories of filth.

Cistern-water should always be filtered before being used for drinking or cooking purposes.

### Springs.

A considerable portion of the water that falls to the earth in the form of rain or snow, sinks into the ground, and passes through rocky strata which are more or less porous or fissured, and issues forth again in the form of springs. The outflow is due to the pressure of water at a higher level, or to the pressure of gases developed deep down in the earth. The water of springs caused in the latter way is often warm or hot, or even boiling, as in the geysers of Iceland or of the western part of the United States, and is generally so thoroughly impregnated with mineral substances as to be entirely unfit for ordinary domestic purposes. Springs furnishing water coming from a moderate depth and that has not been detained in the ground sufficiently long to absorb a large amount of mineral matter, usually afford a supply of pure, cool, and sparkling water, well adapted for ordinary domestic use. The water of springs flowing from a deep source is apt to possess the quality of hardness, but the mineral impregnation is generally less than that of deep-well water. Organic matter, in any considerable amount, is not a common constituent of spring-water, though impurities may gain access to it at its source, or at or near the point of collection. These contingencies may, in great measure, be guarded against.

It may be important to measure the yield of a spring. This may be most easily done by receiving the water in a vessel of known capacity,



such as a tub or cask, and noting the time it takes to fill. The measurement should be taken a number of times, and at different periods of the day. When springs are used for supplying a town, the water is collected from a gathering-ground into reservoirs, and thence is distributed by means of pipes to the places to be supplied. The city of Vienna receives a supply of water from springs which are situated some sixty miles distant (Nichols).

### Various Kinds of Wells.

The different kinds of wells are the shallow, the deep, and the artesian, the latter really being a form of the deep-well. A portion of the rain which sinks into the earth, is retained in the superficial layers of porous soil by an underlying impervious stratum, and constitutes the so-called ground-water. The subject of the ground-water has already been discussed in a previous chapter, and it will therefore be unnecessary to repeat what has there been said.

### Shallow or Surface-wells.

The ground-water is the source of supply of surface-wells. These wells do not usually have a depth exceeding twenty or thirty feet, and if they go deeper are still kept within the porous stratum. The water supplied by such wells may be naturally pure and wholesome; but, on account of its liability to contamination, it must always be regarded with suspicion. In crowded localities, where the soil is saturated with impurities, such water cannot avoid pollution, and its use should be discontinued. Shallow wells constitute a very common source of supply for single families in the country and in small towns and villages, and they are also used, on an extended scale, for town-supplies.

### Area Drained by Wells.

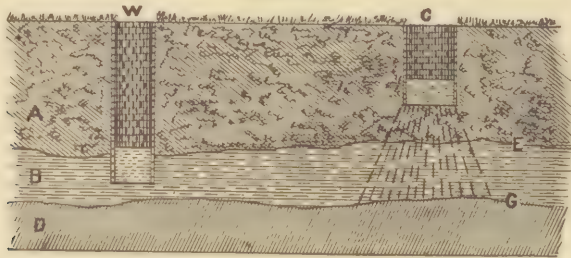
The area of surface drained by wells is a question of great importance, from a sanitary point of view, inasmuch as it bears a close relation to conditions which may impair the wholesomeness of the water-supply by contamination from cesspools, drains, or other sources of filth. These conditions are so variable that it becomes almost impracticable to fix the limits of the area which shall be protective against such sources of pollution. The nature and condition of the soil, the direction of the movement of the ground-water, and the amount of water drawn from the well, all enter into the determination of this question. Efforts have been made to define the safe distance between water-wells and cesspools and other sources of pollution; but there does not appear to be any uniformity of opinion on the subject, nor is this possible under the circumstances. One authority states that a well will drain an area represented by a circle, the radius of which is the depth of the well. But there is evidence to

prove this statement to be a gross misrepresentation of the actual fact. Another authority states that a well should be at a distance of not less than two hundred yards from a cesspool. Twenty or thirty yards is the least allowable distance fixed by the local government laws of England. In Italy, no well is allowed to be sunk within one hundred yards of a cemetery; in France and Austria, two hundred yards is the distance required; and in Belgium, four hundred yards is advised as the distance to be observed to insure protection. Even greater distances have been prescribed in some places. As a rule, the more distant the possible source of pollution, the less will be the risk of pollution; but no limit, unless extreme, will afford an absolute guarantee of safety, as is shown in the case of an outbreak of enteric fever which occurred at Lausen, Switzerland, in 1871, where infectious matter was transported the distance of a mile underground, and polluted a public well with serious consequences (*Rogers Field*).

#### Pollution of Wells.

In order to explain the manner in which a cesspool, usually sunk but a slight distance in the permeable soil, may pollute the water of a well, even though located a considerable distance from the well, use may be made of the illustration at Fig. 109, suggested by Prof. Prestwich. The

FIG. 109.



W, WATER-WELL; C, CESSPOOL; A, GRAVEL; B, GROUND-WATER; D, STRATUM OF CLAY;  
E, GROUND-WATER LEVEL.

figure represents a profile of the soil in which a well, W, and a cesspool, C, have been built. Let A represent a surface-deposit of gravel or other porous material, and D a stratum of clay or other impermeable substance. A portion of the rain which falls upon the ground, sinks through the surface-deposit A, and collects to form the ground-water B, which rises to a certain level, marked E. Now, if a well be sunk into the porous soil below the water-level E, water will flow into it from the surrounding water-charged soil, until it finds a level corresponding with the level of the ground-water E; and as fast as water is pumped from the well, its place will be supplied by a flow of water from the surrounding soil, which tends to maintain the height of the water in the well on a level with the line E. If the pumping be severe, the level of the water in the well, and also in

the adjacent soil, will fall, and water will flow from a more distant point in order to reëstablish the equilibrium; in other words, a larger area must contribute to the supply.

If a cesspool, C, be constructed anywhere in the porous soil A, it will not collect or hold water, because of its situation above the level of the ground-water E. Any liquid deposited in the cesspool C, will pass through its lining (which is usually constructed of brick, laid dry, for the purpose of drainage) into the soil beneath, and will continue downward until it reaches the ground-water B, at or below the level E. Here it will intermingle with and pollute the ground-water, and if the cesspool or privy-vault happens to be situated within the circle of influence of the well, the foul matter escaping from such cesspool or privy-vault will find its way into the well, unless the amount of liquid is too small to saturate the soil. In this latter case, the impure matter will collect in the pores of the ground until the occurrence of a heavy rain, which will pass through the soil, carrying the offensive matter with it into the well. In other cases, a heavy fall of rain will have a purifying effect by dilution. When, for example, liquid filth passes directly from its source into a well, a heavy rain will improve the quality of the water by adding to its bulk.

In small towns and in villages where advantage is taken of the arrangements above described for obtaining a ready water-supply and a convenient means of disposal of house-sewage upon the same premises, without any regard for the natural consequences, the entire water-bearing stratum, in time, becomes polluted, the discovery often not being made until after serious outbreaks of disease have compelled an investigation of their causes to be made.

#### **Relative Positions of Wells and Cesspools with Respect to the Movement of the Ground-water.**

The liability of a well to pollution from a specified source depends a great deal upon the direction of the movement of the ground-water. Take, for example, the case illustrated by Fig. 109. If the direction of the movement is from C to W, the drainage from the cesspool will be carried into the well W. On the other hand, if the direction of this movement is from W to C, it will have the effect of carrying away the impurity without affecting the well, although the two may be near together. This influence of the natural movement of the ground-water may be counteracted by excessive pumping, which has the effect of drawing water toward the well from all directions. However, it may be stated as a wise precaution, not only to locate wells as far as possible from sources of impurity, but also to so locate them that they shall be *above* such sources of pollution,—that is, on the side that shall be in the current of the ground-water moving in the direction from the well toward the cesspool or other source of impurity. To determine the direction of the



flow of the underground water, it is necessary to study the locality, observing that the flow is from a higher to a lower level, and generally towards the nearest water-course. The flow of water is continuous toward the outlet, but its fall does not always correspond with the fall of the land. The height of the water in wells is a good index of the level of the underground water, and by taking the measurement of the level of the water in a number of wells simultaneously, reliable information may be obtained as to the flow of the ground-water, which will be of advantage in locating a well so as to avoid pollution, and also in determining the area from which the supply of water is likely to be drawn.

#### **How to Protect Shallow Wells from Pollution.**

Shallow wells should be protected from immediate contamination by impurities in the soil immediately surrounding, which may be washed into the well with every rain-fall. This may be accomplished by lining the well in its upper part with bricks coated with a good layer of hydraulic cement, or with iron protected with cement or with an indestructible, non-poisonous paint. The surface-water containing impurities, instead of passing directly into the well, would then be compelled to pass through a considerable depth of soil, in which it would undergo a natural process of filtration.

#### **The Effect of Pumping upon the Ground-water.**

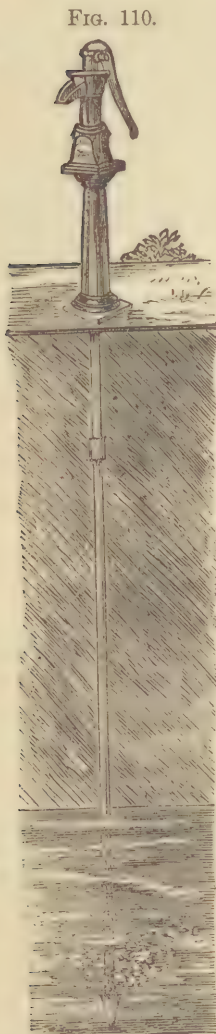
The influence of pumping upon the surrounding ground-water, and upon neighboring sources of pollution, is of so much importance that an explanation is required. When only a very small quantity is pumped from the well daily, the water may stand at, or very near, the same level as in the ground, and the influence of pumping extend to a very slight distance. But, if the pumping be severe, and a large amount of water be taken from the well, the water in the well will first be lowered, and then the effect will extend to the surrounding ground-water. Supposing the water to come as freely from one direction as from another, the depression in the ground-water may be represented by a circle, of which the well is the centre, and toward this centre the water will flow from all directions. The more constant and severe the pumping, the greater will be the amount of depression, and the wider the radius of the drainage-circle. In this way, a cesspool, or other source of impurity, which, ordinarily, when only a small quantity of water is drawn from the well, is beyond the influence of pumping, may be brought within that influence, if the area of supply is greatly extended, as by excessive demands upon the well.

The distance to which the influence of pumping may extend varies according to many circumstances. It may be mentioned that in very coarse gravel, through which water will flow freely, and in some forms of sandstone, in which extensive fissures exist, this influence is most apparent.

In fine sand and fine gravel, where there is considerable resistance to the passage of water, the influence of pumping is very much less.

### Deep Wells.

Deep wells—extending to a depth of fifty feet or more—are those which are sunk in the regular geological formations. Such wells are dug into the ground until they reach a water-bearing stratum beneath the impervious bed of clay or rock which holds the surface-waters, and which, in most cases, effectually shuts out the surface-waters. The quality of the water obtained from deep wells will depend on the nature of the geological strata penetrated. To prevent the infiltration of surface impurities, recourse must be had to lining the sides of the well, at least so much of it as passes through loose deposits of sand, gravel, etc. The manner of doing this has already been pointed out. Deep wells have been used for the supply of towns, especially in England; but the practice is not now resorted to as much as formerly. They are more frequently used for large private establishments, and for work-houses, asylums, and other public institutions; rarely for family supply.



DRIVEN WELL, OR TUBE-WELL.

### Driven Wells or Tube-wells.

*Driven* wells or tube-wells, sometimes called the American tube-well, Abyssinian or Norton's tube-well, are formed by driving into the ground a wrought-iron tube, having at the end a wrought-iron or steel point, above which the sides of the tube are perforated for some distance to admit the water.

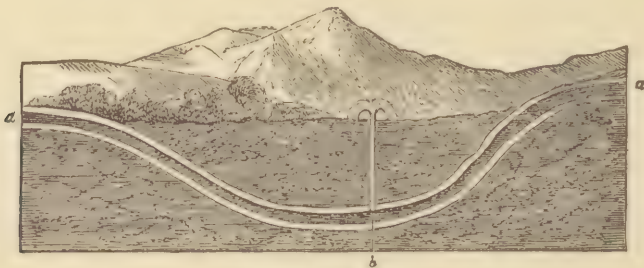
The pipes are generally from one inch and a quarter to two inches in diameter, and are driven into the ground with a mallet or driving-weight. A clamp is usually screwed on the tube to receive the blow. When the tube has been driven so that the clamp has reached the ground, the clamp is moved higher up; and when, finally, the first tube has been driven completely into the ground, a new length of tube is screwed on, and this method is continued until the proper depth is reached. After the water has been reached, a hand-pump of special construction is screwed upon the tube. The water first obtained is more or less muddy and mixed with grit, but it will, in most cases, become clear after continued pumping. Fig. 110 represents a "driven-well" pump in position.

Driven wells may be either shallow or deep. When their source of supply is the ground-water, they belong to the former kind. When driven through a layer of clay, or other impervious material, into another stratum of water underlying the ground-water, they partake of the nature of deep or Artesian wells. It may be seen how tube-wells are superior to dug wells, which, on account of pervious walls or imperfect *steining*, may permit leakage of surface drainage. Another advantage arises from the fact that tube-wells ordinarily draw water from a greater depth than dug wells, where there is less liability of contamination on account of the dilution of impurities in the mass of the ground-water. The deeper forms of driven-wells, which take their water from beneath an impervious stratum of clay, have the advantage of a supply entirely distinct from the ground-water.

### Artesian Wells.

As before remarked, a portion of the rain received upon the earth is absorbed by strata more or less porous, or passes through fissures in rock deposits, and reappears in the form of springs. When a water-bearing stratum is situated between two impervious strata, the water may be retained under considerable pressure. Such water-bearing strata are supplied by the rain which falls on the outcrop, often at a considerable distance from the spring, and at a higher level. When there is a natural opening in the impervious stratum, the water, seeking its level, will rise to the surface in the form of springs; or the impervious stratum may be bored, so as to allow the water to flow to the surface.

FIG. 111.



ARTESIAN WELL.

Artesian wells, so called from having been first generally used in the province of Artois, in France, are wells which are bored through an impermeable stratum until they penetrate a water-bearing stratum, which has an outcrop at some distant point at a higher level. The water, being under pressure, rises in the well to the level of the outcrop, and often flows to a considerable distance above the surface of the ground. Fig. 111 illustrates the theory of the Artesian well as just explained. The water-bearing stratum is represented by *a a*, and the point at which it is pierced by *b*. From the point *b*, the water rises through the tube, or well,



to the surface to seek its original level at *a a*. A great many Artesian wells are now in use in Europe and in the United States, some of them being of great depth (two or three thousand feet or more in depth).

A great disadvantage of these wells is the uncertainty of the quality and quantity of the water. The expense of sinking such a well should not be incurred unless there is a probability of success based upon a knowledge of the geological strata of the locality.

Artesian-well water is generally free from organic substances, but often contains so much mineral matter as to render it objectionable, though not necessarily unwholesome. Coming from a great depth, the water is apt to have a high temperature, or, at least, to be warmer than is agreeable. This objection can be overcome by the use of ice.

### **Precautions with Regard to Dug Wells.**

Dug wells are used as open wells or draw-wells, or are covered and the water drawn out by means of a pump. In order to guard against direct pollution, wells should always be securely covered. In ordinary wells, it is advisable to have a stone coping around the opening, to prevent any refuse or foul water from being washed in by the rains. As little wood as possible should be used about a well, as it is liable to decay and get into the water. Iron is a good material for the pump, and also for the tube leading to the water. All the parts of the apparatus used in drawing the water should be kept in a sound and clean condition, and the construction of the sink and drain should be such as to carry away every particle of water and rinsings, and not allow any of it to leak into the well.

### **Determination of the Yield of a Well.**

The yield of a well can only be found out by pumping out the water, and noting the time required for refilling. If the quantity removed be measured, and the time it takes to refill the well be ascertained, an estimate may be formed of the probable yield of the well. The yield of a well will vary according to season, and therefore examinations should be made at different seasons of the year, in order to form a reliable average estimate of the supply.

### **Rivers and Streams.**

Streams and rivers furnish a convenient source of obtaining a copious supply of water, and are resorted to very generally for this purpose by cities and large towns. The water may be collected or impounded at its source, and distributed to the town through conduits and pipes by the force of gravity. Or, as is very commonly the case, it is pumped into settling basins, or reservoirs, and then distributed. At some works, the water is filtered through beds of sand or gravel before distribution. Most river-waters are contaminated by the discharges of sewage and other

offensive matters in the vicinity of cities, towns, or villages; and it is therefore advisable to take the supply from the head-waters, where there is less risk of pollution. This cannot always be done, and a selection of a station must be made at a point where the water is least liable to pollution. It is always best to draw the water from a point above a city, and as far as possible from human habitations.

### **Pollution of Rivers.**

The convenience of disposal of sewage and refuse of all kinds by discharge into running streams has made them the common depositories for such substances the world over. As a consequence, the water of rivers in populous countries has become polluted to such an extent as to render it, in some instances, unfit for domestic use. In Great Britain, and in some parts of France and Germany, this evil has become of such magnitude as to necessitate the establishment of extensive works for the purification of the water; and costly plans have also been inaugurated for disposing of sewage by some method of purification and utilization.

In this country, many of the rivers carry such a great body of water that the amount of filth discharged into them is too small, in proportion to the volume of water, to exert any appreciable deteriorating effect, except in the immediate vicinity of the discharge. There is a limit, however, to the self-purification of rivers, and, in many cases, this limit is being rapidly approached. A number of places might be mentioned where the water, formerly of good quality, is no longer fit for use. It is commonly supposed that a river carrying a large volume of water, and having a good current, is capable of disposing of the refuse of a large city without rendering the water unfit for domestic use; provided, however, that the point at which the water is obtained is not located below or too near that at which the discharge of sewage and other matters takes place. Acting upon this assumption, many American cities are in the habit of taking their supply of water from the same stream that receives their sewage and other waste matters. In cases in which the most favorable conditions exist for neutralizing the discharged impurities, the practice may be resorted to without any serious disadvantages; but, upon general principles, the habit is one that deserves condemnation.

### **Self-purifying Power of Streams.**

It is true that water, in its flow, undergoes a process of self-purification; otherwise, its use, after it has received refuse and sewage, would be more detrimental to health than it actually is. The principal ways in which this spontaneous purification takes place, are by oxidation, deposition, and dilution. By exposure to air, the organic impurity contained in water is oxidized and converted into simpler and, perhaps, harmless products. It is not possible to tell how long a time this process requires in any given case.

The appearance and quality of the water of a stream are improved by the deposition of insoluble substances upon the bottom, or along the shores. In falling to the bottom, these substances carry with them other matters which, apparently, were held in solution. Owing to chemical changes, which are constantly taking place, new and insoluble compounds are formed, which, in the act of deposition, also carry with them to the bottom some of the matters held in solution. The substances thus deposited, remain at the bottom of the stream, out of harm's way, or are shifted about from place to place by the force of the current, or are stirred up and swept away by the action of floods.

Another way in which water purifies itself is by dilution. The amount of sewage or other filth poured into a stream may be so small, in comparison with the bulk of water, that it becomes quickly divided up and scattered, so that a chemical test may fail to detect it.

While these natural processes of purification are of immense advantage, it cannot be said that any of them are to be trusted, however complete the result may appear to be. Sewage, made up in part of fecal matter, may contain the evacuations of persons suffering from specific diseases. Such evacuations are supposed to contain morbid elements, or germs of disease, which, owing to their great tenacity of life, may escape destruction by chemical action. If this be true, the effect of dilution is to disperse and diffuse throughout the mass of water these particles of poisonous matter; and, to that extent, diminish the harmful property of the water. Prof. Nichols attributes important results to the influence of dilution, at the same time admitting that a large amount of organic matter is destroyed by chemical change. He lays great emphasis on what he believes to be a fact, namely, "*that the apparent self-purification of running streams is largely due to dilution, and the fact that a river seems to have purified itself at a certain distance below a point where it was certainly polluted, is no guarantee that the water is fit for domestic use.*"

### Storage of Water

Water is stored on a large scale, in reservoirs, for the supply of towns and cities, or it is stored in tanks and cisterns in or near dwellings for the supply of the household. Large reservoirs for public supply are built of earth and masonry; tanks and cisterns for private supply are constructed of different materials, such as brick, iron, zinc, lead, slate, and wood. Lead should never be employed for reservoirs supplying water for drinking and cooking purposes, as there is danger of poisoning from this source. Zinc is less dangerous, but it is better to avoid its use. Iron is sometimes used, and with advantage, provided the inside be covered with some protective material, such as hydraulic cement. Otherwise, the metal is rapidly eaten away, and rust forms, which discolors the water and renders it unpalatable and unsuitable for washing



purposes on account of staining the clothes. Zinked, or "galvanized," iron, as it is commonly called, is frequently employed for the purpose of preventing rust. The coating of zinc protects the iron for a time, that is, so long as the corrosive action of water is confined to the zinc. But after a time the zinc coating becomes destroyed, and iron rust begins to form. Tanks are sometimes made of pine or cedar, but the wood gives an unpleasant taste to the water, and a further disadvantage is the difficulty in keeping the tanks clean. In New Orleans, cypress wood is very commonly used for this purpose. Cisterns are frequently built of brick, and are very serviceable, if well constructed and properly lined with good cement. If mortar be used, the lime contained in it will gradually dissolve and give to the water the quality of hardness. It is also more perishable than cement. Perhaps the best cisterns are those constructed of slabs of slate well put together with cement, and not with lead, as is sometimes the custom.

#### **Dangers from Storage of Water in Tanks and Cisterns.**

Great care should be exercised in keeping the cisterns thoroughly clean, and in avoiding all sources of contamination. To accomplish this object frequent inspections should be made ; and, as deposits are sure to occur, even from the best water, it is a good plan to draw off the water three or four times a year, and thoroughly scour and cleanse the interior of the cistern.

Tanks and cisterns should be covered in, to prevent the entrance of impurities. They should also be ventilated ; otherwise, the water may become impure. Cisterns should have depth rather than width, to secure coolness and prevent evaporation ; and if exposed to the danger of freezing, it is a wise precaution to have them wider at the top than at the bottom, to give room for the expansion which takes place during freezing. When cisterns are placed beneath ground, the greatest care will be required to protect them from the access of surface and soil impurities of any kind.

Overflow-pipes are often a direct source of water contamination. In no case should these pipes be connected with drains or water-closet basins, as is sometimes done. The danger in such cases arises from the passage of foul air into the cistern, where it is absorbed by the water. To avoid such a risk, the overflow-pipes should be carried into the open air, or terminate at the ground near a trapped grating connected with a drain. A water-closet should never be supplied directly from the common cistern, as the pipes leading to the closet may conduct foul air to the cistern. Each water-closet should have a separate cistern, not only as a means of preventing pollution of the general supply, but also to afford the most advantageous method of flushing the apparatus.

Wells should be carefully guarded from contamination by surface washings or by soakage from the soil immediately surrounding them. They should be carefully covered in, and a good stone coping built around them. To prevent soakage, it may be necessary to use a lining of iron or of brick covered with a good layer of hydraulic cement.

#### **Hydraulic Rams.—Pumping by Wind.**

Water is sometimes supplied to cisterns by the use of hydraulic rams. All that is required is a sufficient fall of water to work the ram. When water-power is not available, recourse is often had to wind-power, which has the advantage of small expense. Wind-mills are very frequently used in the country, and the plan seems to be growing in favor. It has the disadvantage of uncertainty of supply, as there may be intervals of days when the force of the wind is insufficient to work the pumps attached to the apparatus. It is therefore necessary to make ample provision for such contingencies by having the tank or cistern of sufficient capacity to hold a supply for several days, or the longest period during which it is probable the pumps will be inactive. If there is high ground near the house, advantage may be taken of it for the location of the cistern or reservoir. Otherwise, it will be necessary to construct a water-tank in the upper part of the house, say, under the roof.

#### **Distribution of Water.**

The method of distributing drinking water from wells, reservoirs, or other sources of supply, is of much importance. The materials used for conveying water are generally iron, lead, or tin. The primitive method of carrying water in buckets or other receptacles from a public fountain, well, or other general source of supply, is not often resorted to, though this custom still prevails to a limited extent in some of the towns of Continental Europe. Water supplied from public reservoirs, or directly from the source, is distributed by means of pipes, which are usually of cast-iron.

#### **Intermittent and Constant Systems of Supply.**

Water supplied in this way may be by one of two systems, namely, the *intermittent* system, which necessitates storage in house cisterns; and the *constant* system, in which the pipes are always kept full, and no storage is required in the house. The intermittent service has been extensively used in Great Britain, but is gradually going out of use on account of its many and serious disadvantages. With this system the water is turned on for a part of the day only, and it is therefore necessary to provide tanks and cisterns for storing a sufficient supply during the intervals. Apart from the inconvenience and expense of providing cisterns and keeping them in proper condition, there is the risk of contamination of the water by accumulations of suspended matters, dust, and other impur-

ities, which oftentimes render the water unfit for use. The vigilant inspection and constant care required in keeping these storage receptacles clean, especially in the houses of the poor, are such irksome duties that it cannot be expected that it will always be properly done, and the chances of contamination will always be great. Another disadvantage arises from the use of overflow-pipes. Where there are cisterns there must of necessity be waste-pipes, to prevent damage from an overflow of water. These pipes are frequently connected with drains, or with some part of the water-closet apparatus, and by this means foul air may be brought into the house and contaminate the water. It is further urged against the intermittent system, that foul air and foul water may find their way into the distributing pipes during the intervals when they are not charged with water; and thus, when the water is again turned on, a polluted supply may be carried into the cistern. The want of water, should there be a sudden demand for it, as in the case of fire, is a further disadvantage of no trifling character.

#### **The Great Advantages of the Constant System.**

All these objections are overcome by the adoption of the constant system. Reservoirs are rarely required, except for the supply of water-closets. The distributing pipes, being always full of water under pressure, are not likely to receive foul matters from the soil. At the same time, it is not proper to place them near sewers or other sources of pollution, as impure matters might be drawn into the pipes under certain conditions, impossible to foresee. Water served by the constant system is fresher, purer, and cooler in summer time, than it would be if stored in tanks.

It is very important that the service should be kept up to the prescribed conditions, and provide a sufficient supply at all times without any intermission. It has happened in the practice of the constant service system, that the water has been supplied on the intermittent system for a few days for the purpose of cleansing reservoirs or making repairs, or for some other object. Under these circumstances, there is a risk of suction of gases and fluids into leaky mains, or into pipes supplying water-closets or other receptacles containing impure substances. By intermitting the supply in a system conducted upon the constant service plan, grave results may be produced in the manner just described, and they have actually occurred; as, for example, in the town of Croyden, where an outbreak of fever was traced to this cause, the danger having been foreseen and cautioned against. Defects which make such accidents possible ought not to exist. Water-closets and other vessels containing foul matter should never be connected directly with a service-pipe; on the other hand, a system designed to furnish a supply on the constant plan, should be such in fact as well as in name. No system is complete without the



provision of two or more reservoirs, so as to avoid the necessity of a stoppage of water for the purpose of cleansing a reservoir, or for other reasons.

It is urged against the constant system, that a great waste of water must necessarily accompany its use. But this can and should be guarded against by the use of good fittings, and by careful inspection. Water meters have been suggested, and, in some places, have been put into use; but their employment is not to be advised upon sanitary grounds.

#### **Plans for the Distribution of Water to Every House to Include the Means for the Speedy Removal of Dirty Water.**

Convenience in obtaining water is an aid to its free use, and, therefore, to cleanliness and health. Every house should have its own supply of water; and it may not be extravagant to advise that water should be distributed to every floor in a house, especially when a building is occupied by several families, as in the case of flats and tenements. It often happens that several houses are supplied by a single hydrant in the yard, which is their common property. The trouble and labor of carrying the water operate against its free use, and proper cleanliness is not maintained. Some cities require, as a sanitary measure, that every house shall have a separate supply of water.

An essential point in the plans for the distribution of water, is the provision of a means of speedy removal of dirty water; otherwise, the want of such provision will necessarily limit the use of water, even though the supply may be ample.

#### **Means of Distribution.**

Whatever system is used, the water is conducted from the reservoir in pipes of various kinds. Wooden pipes, hollowed out of the trunks of trees, were formerly used, and are sometimes still employed. Nearly all distributing-pipes are now made of iron, which has been found to be the most serviceable material. It is, however, not without its objections; but these are of no great moment. Almost all waters act upon iron, and cause the formation of rust. The amount of iron taken up by water in its passage through pipes is not regarded as deleterious to health. In old pipes in which the erosion is extensive, the presence of iron in solution or in suspension may be considerable, and impair the quality of the water, and sometimes render it unfit for washing and cooking. The formation of "tubercles," by which the capacity of the pipes and the flow of water are diminished, has often given a great deal of trouble, and it may have such a serious effect upon the flow as to require scraping of the pipes.

To overcome these objections of rust, various expedients have been tried. The process most commonly employed is that devised by Dr. Angus Smith, which consists in coating the pipes with coal-tar pitch while

at a high temperature. The Bower-Barff process of producing a coating of the magnetic oxide of iron on the surface of iron may be utilized to protect water-pipes from corrosion.

### **Action of Water on Lead Pipes.**

Pipes of various kinds are used for distributing water within the house. Lead, iron, block-tin, tin-lined lead, tinned copper, and zinc, have all been used. Lead is the material most extensively employed, on account of its durability, and the facility with which it can be bent and fitted. It has the disadvantage of being acted on by certain waters, which attack and dissolve lead, and are thereby rendered poisonous. The waters which act most on lead are chiefly pure and soft waters, and those containing organic matter. Rain-water and distilled water, and even soft well-water and the water of some streams, will dissolve lead in sufficient quantity to make them poisonous. Wanklyn states that drinking-water is unsafe if it contains as much as one-tenth grain of lead per gallon. According to Dr. Parkes, any quantity over one-twentieth of a grain per gallon should be considered dangerous, and some persons may be affected by even smaller quantities.

### **Protection of Lead Pipes.**

Considering how common is the use of lead for service-pipes, it may appear strange that cases of lead-poisoning are not more frequent. This may be explained by the fact that river-waters and some well-waters contain mineral salts, such as the carbonates, sulphates, and phosphates, which form a crust on the inside of the pipes, and so protect them from any further corrosive action. Hot water always acts more freely on lead than cold water, and, therefore, it is a wise precaution not to use water for drinking purposes that has been in the pipes while hot. Water that has lain in the pipes a long time should never be used for drinking or cooking purposes. When new pipes are introduced, it will be safer to allow the water to run to waste, at intervals, until a sufficient time has been allowed for the initial action of the water on the lead to take place.

Lead pipes are unsuitable for conducting rain-water, or water from wells. In these cases, the action of the water on the lead is apt to be violent, and lead-poisoning may be the result. In any specific case, a chemical analysis of the water should first be made to discover the effect of the water on the lead. As a protection for lead pipes, a lining of tin has been recommended; but, unless the lining is of considerable thickness, it may give way, and galvanic action between the two metals be set up, which would have the effect of causing a greater solution of the metal. A block-tin pipe enclosed in a lead pipe forms a more reliable means of protecting the lead from the action of water.

### Substitutes for Lead Pipes.

As a substitute for lead we may employ block-tin pipes, which are little acted on, but their cost is an objection. Copper pipes lined with tin have been used, but there is the same objection to them as has been urged against tin-lined lead pipes. Glass-lined iron pipes have been patented, but their utility has not been fully demonstrated.

The best substitute for lead pipes is iron pipes. They may be made of either cast-iron or wrought-iron. Hot water acts upon iron, and the effect may be disagreeable. The zinc in galvanized-iron pipes is slightly acted on by water, but if the precaution be taken to allow the water to run a while before its use, no injurious effects need be apprehended. In practice, it is found that the zinc affords protection to the iron only for a time, and that eventually rust will begin to form. According to Prof. Nichols, "One of the best materials for service-pipes is wrought-iron protected by the Bower-Barff process, provided practical experience justifies the theoretical expectations. To such pipes, coupled without the use of red or white lead, there can be nothing superior from a sanitary point of view, and for use in wells and cisterns they will supply a very serious want."

The great convenience of lead makes it an exceedingly desirable material for service-pipes, were it not for the danger of poisoning. There are, however, conditions under which it may be safely used, which have already been pointed out. To broadly condemn its use on purely theoretical grounds would be ill-advised. Practical experience, after all, must be the guide, and such experience has shown, by the examples of New York, Philadelphia, Boston, Glasgow, Manchester, and of many other cities, that, as a rule, there is no danger in using lead pipes for house distribution in connection with a public supply (Nichols). In the case of rain-water and well-waters, and some soft waters, this protective action cannot be depended on, and lead pipes should be discarded, and some other form of service-pipe substituted in their place, as already advised. Every house supplied by a public system should be provided with a good screw stop-cock, placed just outside the house, or at a point where the pipe enters the house, the object being to turn the water off in case of a leak, or to empty the pipes, as during frost.

### How to Protect Pipes from Freezing.

In cold climates, the pipes should be kept well underground to prevent freezing, and they should be protected in the house as much as possible from exposure to cold. If the spigot be turned so that the water may escape by drops, freezing may be prevented, or, if it does occur, with this precaution, the pipes are less likely to burst.



**Convenient Test for the Presence of Lead or Copper in Water.**

A very convenient test of the presence of lead or copper in water is afforded by the use of sulphide of ammonium, which will produce a dark color in water containing lead, copper, and even iron, the depth of which is proportional to the amount of metal present. Place a gallon of the suspected water in a dish of white porcelain, and stir up with a glass rod which has been dipped in sulphide of ammonium; if a dark color is produced, it is due to iron, or lead, or copper. Then add a few drops of hydrochloric acid, and note the effect upon the color. If the color disappears, it is due to the presence of iron; if it does not, it is due to the presence of lead or copper, and whether the metal be lead or copper makes no difference, as either metal, if present in sufficient quantity to become visible (one-tenth grain of lead or copper in a gallon of water is quite visible with the test), would condemn the water. Water which remains colorless under this test is sufficiently free from poisonous metals; and, on the other hand, water which does not, is to be condemned as being contaminated with metallic impurity (Wanklyn).

**Sources of Impurities in Drinking-water.**

Reference has already been made, in the preceding pages, to the origin of the impurities found in drinking-water; but it will be advantageous to consider the subject more in detail, especially in its relation to some of the more common sources of pollution. The nature of the soil and the character of the geological strata through which water has passed, influences its composition to a very great extent; so that waters derived from certain kinds of soils and from certain geological formations, are often classed according to their sources, and have general characteristics in common, which serve to distinguish them from one another. Thus, for example, we speak of limestone waters, of chalk waters, of clay waters, of waters derived from loose sands and gravels, of waters from the granitic and metamorphic formations, of alluvial waters, and of marsh waters, and so forth; and we are accustomed to attribute to them peculiarities of composition, which help to determine their fitness or unfitness for use.

Granites, gneiss, trap-rock, and clay-slate, do not often contain much soluble matter or organic impurity, and therefore, generally yield a pure water. Waters from sandstone formations vary in their quality and composition, but generally contain a good deal of salt, and considerable carbonate of sodium, sulphate of sodium, iron, some lime and magnesia, and organic matters. The chalk, limestone, and magnesian limestone strata yield hard water. If the hardness is due to the presence of carbonate of lime or magnesia, it may be removed by boiling; if due to the presence of the sulphates of lime and magnesia, it cannot be removed by boiling, and the water is therefore objectionable for domestic purposes.

Some sands and gravels contain a very considerable amount of salts and organic matter, and yield impure water. In other sands and gravels, the saline constituents and organic matter exist in very small amounts, and the water is very free from impurity. Alluvial waters generally contain a very considerable amount of solids and organic matter, and are therefore generally impure. The waters from marshes almost always contains a very large quantity of vegetable organic matter, and a variable amount of solids. With few exceptions, such waters are unfit for domestic purposes.

Water taken from wells near the sea may contain so much saline matter as to have a decidedly brackish taste. Such water is not considered wholesome, as it is apt to affect the bowels, though people use it and appear to like it. Rain-water derives impurities from the air, but more commonly from the unclean surface on which it falls.

### **Pollution of Drinking-water.**

The accidental impurities which find their way into water through the carelessness of man, are of a graver character. Water may be polluted at its source, during collection, in the course of distribution, or while being stored.

### **How Public Supplies become Polluted.**

Rivers, streams, and lakes, which furnish supplies to towns and cities, are often polluted, in some cases seriously, by sewage and manufacturing wastes, and other refuse matters of an impure character. Sewage is a heterogeneous mixture composed mainly of solid and liquid excreta and the slops and waste-water from dwellings, of solid and liquid waste from industrial and other establishments, and of the washings from streets and other exposed surfaces. In addition to this material, there is often a direct discharge of manufacturing refuse from dye and bleach works, from tanneries, from worsted and woollen mills, and from paper works; of the poisoned water from mines and chemical works, and of the solid and liquid refuse from slaughter-houses and soap-boiling establishments. The soakage from graveyards on the banks of a river may form a source of contamination. Refuse from old buildings and street-sweepings, and even the carcasses of dead animals, are often disposed of by being thrown into the water. Comparatively small streams soon become polluted to a dangerous extent by such abuse. Large rivers, on account of their great volume of water, have the power of freeing themselves from organic pollution by dilution, oxidation, and deposition, to a greater extent than small streams, though they too may become dangerously contaminated in some part of their course; as, for example, in the vicinity of towns and cities.

The discharge of sewage into a lake or body of still water, is always a serious matter, if the water is used for household purposes. Even the great lakes of the West, which contain vast volumes of water, cannot safely be used as reservoirs for the impurities coming from houses. The cities of Chicago, Cleveland, and Milwaukee dispose of their sewage by draining it into the great lakes on which they border, and, at the same time, receive their water-supply from these bodies of water at what was supposed to be a protective distance from the outlets of sewers. In all these cases, the contamination of the water is becoming a serious matter, and will at no distant day compel the adoption of some other plan of sewage disposal.

#### **Effects of Pumping upon the Ground-water.**

Deep wells or springs supplying a public system may become contaminated by the entrance of surface washings, or by impurities drawn from a distance. Such wells or springs situated at a low level may drain a district of extended area. Severe and continued pumping may have the effect of drawing water from very distant points. Experiments made with the view of determining the extreme distance to which the influence of pumping extends, have been carried out in a number of instances, with results that warn us against the too close location of wells to sources of impurity. Two or three of these experiments may be alluded to. In a well at Leipzig, dug in very coarse gravel, the influence of pumping extended a distance of 1,050 feet, the depression of water in the well being six and seven-twelfths feet. When the depression was reduced to twenty and three-twelfths feet, the influence of pumping extended to the extreme limit of 1,378 feet. At Gravesend, in a well excavated into chalk, the extreme distance of the influence of pumping was 600 feet, while the depression of water in the well was ten and a half feet. A well at Liverpool, in the new red sandstone strata, drew water an extreme distance of 11,710 feet, the depression of water in the well being eighty-two feet. These and some other examples, are furnished on the authority of Messrs. Rogers Field and J. Wallace Peggs. It will be seen by these experiments, how a well, when forced to yield its maximum quantity of water, may imbibe foul matter from a cesspool or other source of impurity very distantly located, and therefore supposed to be beyond the circle of influence. The amount of area drained by a well may be determined by experiments similar to those above alluded to, the effect of pumping on the water-level of wells in the surrounding territory giving the information desired.

#### **Pollution of Water during Distribution.**

Public supplies are exposed to pollution in the course of distribution, and during storage. The water may be contaminated by dissolving the



metals that compose the distributing-pipes. Iron pipes, if not sufficiently protected against corrosion, will rust, and render the water turbid, and possibly unfit for washing and cooking purposes. Leaden pipes, though generally protected by a spontaneous deposit of partly insoluble substances, may give to the water a poisonous quality, if the water-pipes are new, or if the water has lain in the pipes a considerable time, or is drawn from hot-water faucets.

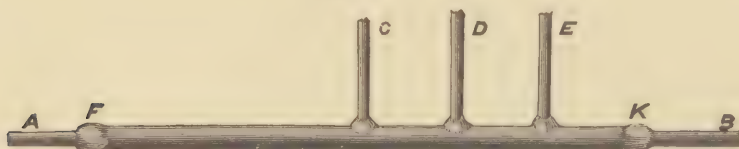
The distributing-pipes, when empty, may admit impure air and liquid matter, through leaky joints or other openings. Service-pipes connected with water-closets—a very common arrangement—may suck up liquid filth and foul air when the pipes are becoming empty. This is one of the dangers connected with the intermittent system. But it may also happen with the constant system. Though the water is supposed to be constantly under pressure, sufficient to prevent any in-current, there are conditions under which in-currents from leaky mains become possible, as demonstrated by Dr. Buchanan. For this reason, water-mains should not be laid down too near sewers, drains, gas-mains, or other possible sources of impurity. Coal gas is known to have entered a water-main when, from some cause or another, it was empty.

#### **Intermittent House-supply from Improper Arrangement of Service-pipes.**

Owing to an improper arrangement of the service-pipes in a house, the flow of water on the upper floors is very apt to be intermittent, on account of want of pressure. If the pressure is maintained in the street mains and in the main service-pipe in the house, this will not occur. But it so happens with the ordinary arrangement of service-pipes, that when a cock is turned on in the kitchen or ground-floor, any one needing water in an upper story must wait until the spigot below has been turned off, and the pipe has refilled. This is not only a needless inconvenience, but a source of danger. The water-closet being connected—and very improperly—with the service-pipe for the purpose of flushing, will furnish foul air and perhaps foul matter, should the pan be full, to the service-pipe, if the valve is open when the flow is stopped. The suction power is caused by the fall of water in the service-pipe, which takes place when the pressure is lost by turning on a cock in the basement-floor. To prevent such an accident, water-closets should have no direct connection with the service-pipe, but should always be flushed by separate cisterns. To avoid the inconvenience of an intermittent house-supply, Mr. Bayles suggests a very simple plan which is illustrated by Fig. 112. The street main is tapped by a five-eighths-inch ferrule and a three-fourths-inch pipe, A, is brought within the house, where a stop- and waste-cock is inserted to control the supply. From this point, the water is carried the entire length of the house by a pipe, F K, two inches or more in diameter. From the

extremity a five-eighths-inch pipe, B, is carried to the hydrant in the rear, and a separate line of five-eighths-inch pipes, C, D, and E, is taken off at different points in the enlarged pipe, and carried up to each floor. The

Fig 112.



PLAN FOR PREVENTING INTERMITTING FLOW ON UPPER FLOORS.

enlarged pipe acts as a reservoir in which there is less friction and a greater available flow of water for the upper stories.

#### Pollution of Water through Defects Connected with its Storage.

If water is stored on the premises, there is the danger of contamination from improper connections for flushing the water-closet. The overflow-pipe may discharge into a drain, and sewer-gas gain access to the water through this channel. There is, moreover, the danger from foul tanks and from metallic impregnation from leaden cisterns.

#### How Shallow Wells become Polluted.

The water-supply of rural and suburban districts is constantly liable to pollution from all sorts of impurities coming from dwellings. The most frequent and dangerous source of contamination is the cesspool or privy-pit. People seem to forget that the property of the soil that permits them to conveniently get rid of liquid excreta, house and waste water, is that which enables the rain to supply their wells with water; and when a cesspool is placed near a well, its liquid contents may reach the well through the same channels that the rain does. Prof. Prestwich remarks, that the permeability of the soil "has, for ages, been taken advantage of for the double purpose of obtaining a ready water-supply and a ready house-drainage; and it is a disgrace to the civilization of the nineteenth century that a practice, begun long ago in ignorance and amongst a scanty population, should have been allowed to continue unchanged and in its primitive rudeness, with all our knowledge and experience, and amongst our teeming population."

The Rivers' Pollution Commissioners of Great Britain, in their Sixth Report, describe, in no unmistakable terms, the character of the water-supply obtained in many portions of the rural districts of that country; and as it illustrates a practice that too often occurs in this country as well, an extract from their report may serve a valuable purpose. They remark that twelve millions of the country population in Great Britain "derive

their water almost exclusively from shallow wells, and these are, so far as our experience extends, almost always horribly polluted by sewage, and by animal matters of the most disgusting origin. The common practice in villages, and even in many small towns, is to dispose of the sewage and to provide for the water-supply of each cottage, or pair of cottages upon the premises. In the little yard or garden attached to each tenement, or pair of tenements, two holes are dug in the porous soil; into one of these, usually the shallower of the two, all the filthy liquids of the house are discharged; from the other, which is sunk below the water-line of the porous stratum, the water for drinking and other domestic uses is pumped. These two holes are not infrequently within twelve feet of each other, and sometimes even closer. The contents of the filth-hole or cesspool gradually soak away through the surrounding soil, and mingle with the water below. As the contents of the water-hole or well are pumped out, they are immediately replenished from the surrounding disgusting mixture, and it is not therefore very surprising to be assured that such a well does not become dry even in summer. Unfortunately, excrementitious liquids, especially after they have soaked through a few feet of porous soil, do not impair the palatability of the water; and this polluted liquid is consumed from year to year without a suspicion of its character, until the cesspool and well receive infected sewage, and then an outbreak of epidemic disease compels attention to the polluted water. Indeed, our acquaintance with a very large proportion of this class of potable waters has been made in consequence of the occurrence of severe outbreaks of typhoid fever amongst the persons using them."

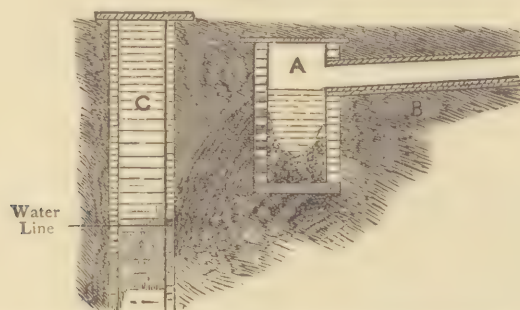
#### **Leaking Cesspools a Frequent Cause of Contamination of Water in Wells.**

The above description of a most disgusting practice, which prevails very generally in the rural sections of Great Britain, is unfortunately not without application to some portions of our own country. The freedom with which the soil disposes of liquid matter is taken advantage of, not only to get rid of liquid excrement, but also for absorbing the waste water from the house. For this purpose cesspools are constructed with porous walls and bottom. When bricks are used, they are put together without mortar, so that as much liquid as possible may percolate into the surrounding soil. House-drains are made to empty into cesspools for the sake of convenience, and also to take advantage of the solvent power of the water of the sewage, in aiding the escape of as much as possible of the contents into the soil. When the ground is very porous and admits of free percolation, it is sometimes the practice to seal the cesspool, and conduct into it most of the sewage from the house, including the waste from water-closets. These cesspools are placed under the house or outside in its immediate vicinity, and at no great distance from wells supplying



drinking-water. What happens may be seen from the accompanying illustration, Fig. 113, which is borrowed from Prof. Corfield's paper on *Defective Sanitary Appliances*. The bottom of the cesspool being above the level of the ground-water, any liquid poured in the cesspool will pass

Fig. 113.



CESSPOOL LEAKING INTO THE SOIL AND CONTAMINATING THE WATER IN WELL. A, CESSPOOL; B, DRAIN; C, WELL.

through its porous walls and open spaces down through the soil until it reaches the ground-water, with which it mingles. As the contents of the well are pumped out, their place is supplied by water impregnated with sewage, and, in this way, the well-water is continually polluted.

Rubbish-heaps, accumulations of manure, and collections of filth about country houses, are always a nuisance, and may be the cause of polluting the water in wells in the way above described.

#### Abandonment of the Cesspool Nuisance Advised.

To prevent contamination of the water-supply, the leaking cesspool should be abandoned, and some form of dry removal substituted in its place. Earth-closets or water-tight tubs or boxes for solid and liquid excreta will answer the purpose, provided they are properly made and adjusted, and frequently removed. The wells should be protected from soakage from the surrounding soil by a proper lining of impervious material. Shallow wells are always more or less liable to pollution, and should be abandoned wherever practicable, and the deep well or driven well substituted.

#### Other Sources of Contamination of Water in Shallow Wells.

Surface-wells are often polluted by impurities washed into them from the surface of the ground during a fall of rain. To avoid this accident, a coping of stone should be constructed around the well, as a protection.

The water in wells frequently becomes impure by the collection of deposits, and by the entrance of small animals, and other extraneous substances, such as dust, leaves, and decayed wood. A proper covering will prevent the entrance of such impurities, and periodical cleansing

will aid in maintaining the water in a pure condition. In cities, towns, and large villages, or wherever a public supply is available, the use of water-wells should be forbidden, as the ground-water in all populous places is almost invariably seriously polluted by the ooziings from cess-pools, drains, and sewers. Coal gas may also pass into the ground from leaky gas-mains, and find its way into the wells.

Cisterns and tanks for the storage of drinking-water always require the greatest care, as the chances of impurities getting into them are very great.

### **Purification of Water.**

Water used for drinking purposes should be obtained from a pure source, or, at least, from a source that is unpolluted. It is, however, not always practicable to obtain a supply of an unobjectionable quality. Springs and wells may furnish pure and wholesome water, but the quantity is limited. When people collect together in towns and cities, a supply must be provided on a large scale. It becomes necessary to resort to streams and rivers as the source of water-supply. River-water is liable to become turbid by rains and freshets, and it is not infrequently polluted by sewage. Water impregnated with sewage cannot be rendered wholesome by any process of purification that has to be conducted on a large scale; but the character of many waters may be greatly improved by artificial means.

### **Sedimentation and Filtration.**

The means of purification of water are those made use of on a large scale in connection with public supplies, and those adapted to domestic purposes. By sedimentation we can get rid of a large quantity of the suspended matters, and what remains may be removed by the process of filtration, which also removes an appreciable amount of the dissolved organic substances. Both of these processes should be made use of in providing public supplies.

### **Filter-beds.**

The process of purification is conducted on an extensive scale by receiving water into large reservoirs, where the coarser suspended matters subside, and then by passing it through filter-beds of sand and gravel. The filter-beds are water-tight basins, with sides constructed of masonry and the bottom paved with brick and cemented. Upon the floor of the basin are laid a series of open-jointed drains leading to a central outlet. Over these is placed a layer of broken stone, the pieces being not more than four inches in diameter. A layer of gravel comes next, which is coarse at the bottom and gradually becoming finer as the surface is approached. Then follows a stratum of sand, which is likewise coarse at the bottom

and becomes finer toward the top of the layer. The depth of the filter-bed is subject to considerable variation, but it is generally between three and five feet. The pressure of water is purposely kept low, so that the process of filtration shall not be too hurried. The depth of water is therefore seldom ever more than two feet; in some cases it does not exceed one foot. The vertical rate of descent should not be more than six inches per hour. At this rate, twelve cubic feet, or eighty-nine and three-fourths gallons, will be delivered in the twenty-four hours from each square foot of surface.

#### **Action and Limits of Filtration.**

The action of filtration is chiefly mechanical. The effect is first to arrest the coarser particles that are too large to enter the body of sand. In the second place, the suspended impurities, both mineral and organic, small enough to enter the interstices in the filtering material, adhere to the surfaces of the sand, which, in time, become coated, and the sand has to be removed for cleansing. The effect upon the dissolved mineral and organic matter is less appreciable. The dissolved organic matter is removed, to a slight extent, by adhesion to the angles and surfaces of the sand. It is also supposed that a small amount of this matter is destroyed by oxidation, which is brought about by the presence of air in the interstices of the sand, and by the oxygen held in solution in the water. The efficiency of this action depends on the fineness of the filtering medium, the rate of filtration, and on the thoroughness and frequency of cleansing. Sand filtration is not very efficient in removing dissolved mineral substances in excess. It has the power of arresting the salts of lime to a limited extent; it also removes considerable salt. but, in time, the bed becomes clogged and must be renewed.

#### **Materials used for Filtration.**

As the organic matter is the impurity most desirable to have removed, various substances have been used with the object of more effectually arresting and destroying this matter by chemical action. Charcoal, carbide of iron, spongy iron, and carfural, have all been used with more or less success. Prominence has lately been given to the use of Bischof's spongy iron, by an experiment upon a large scale at the water-works at Antwerp, which is claimed to be a success.

For domestic purposes water may be purified on a small scale in various ways, which may be conveniently described under the heads of purification without filtration, and purification with filtration.

#### **Purification without Filtration.**

The exposure of water in minutely divided currents to air has been practiced, and with good effect. The water may be poured through perforated tin, wood, or zinc, and allowed to fall in finely divided streams, or



it may be pumped from one cask into another having a perforated partition in it near the top. The plan is a rude one, but may come in use in the absence of more convenient methods.

### **Distillation.**

Distillation is a most effectual means of purification. By this process, all solid impurities are removed; but volatile matters, such as ammonia, carbonic acid, and any organic compounds that may be present, will pass over with the vapor. If the first part of the distillate be rejected, we may obtain a water that is perfectly free from any injurious property. The great objection to distilled water is its flatness and unpalatableness, though some persons become accustomed to this peculiarity and prefer the water to all others. The unpleasant flavor may be gotten rid of by exposure to the air, and an agreeable temperature may be secured in summer by the addition of ice.

### **Boiling an Effectual Means of Purification.**

Boiling is a simple and sure plan of overcoming the injurious influence of contaminated water. It is highly probable that boiling will effectually destroy the specific poisons of such diseases as typhoid fever, cholera, or others, which are sometimes contained in water polluted by sewage. It has often been observed during a local epidemic of typhoid fever, that those who have been affected by this disease were in the habit of drinking water cold, while those who only took it after it had been boiled, as in the form of tea or coffee, have escaped. As bearing on this fact, Dr. Harts-horne cites the occurrence at St. Mary's Hall, Burlington, N. J., where, as related by Dr. Leconte, thirty cases of typhoid fever occurred within two weeks from drinking water contaminated by leakage from a privy-vault. None of the servants of the house, who drank only tea or coffee and seldom cold water, were attacked; while the boarders, who drank cold water freely, often between meals, were those from among whom all the cases occurred. In speaking of the protection afforded by boiling water, Dr. de Chaumont says, that "we may rest assured that no disease-poison, however virulent, will resist the temperature of boiling water, and that water so treated may be taken without fear of bad results, even though it may have been previously seriously contaminated."

Boiling removes that form of hardness which depends on the presence of the carbonates of lime and magnesia. Water that has been boiled is flat and insipid; but the flavor may be greatly improved by pouring the water from a height from one vessel into another.

### **Purification by the Addition of Substances to the Water.**

By the addition of alum to water,—a practice that has been used for centuries for purifying water,—suspended matter, both mineral and

organic, is promptly precipitated and the water rendered clear. The efficiency of this plan depends on the presence of carbonate of lime, which unites with the alum, forming new compounds. These fall to the bottom and carry with them the suspended matters. It is very doubtful whether an appreciable effect is exerted upon the dissolved organic matters. About six grains to the gallon is the proper proportion of alum to use. If we exceed this quantity, we may give to the water an undesirable quality of hardness.

A purifying effect is obtained by boiling astringent vegetables in water. Tea is a good example. The organic matter is rendered harmless, not only by the boiling, but also by the influence of the tannin, which coagulates and precipitates such matter.

The immersion of pieces of charcoal, iron-wire, and magnetic oxide of iron, is sometimes practiced for their purifying effect. The inside of a cask may be charred with the same object. Frequent renewal of the materials is required in all these cases, if their effect is to be depended upon.

#### Purification with Filtration.

The filtration of water on a large scale in connection with public supplies has already been explained. It is manifestly the duty of water companies to deliver water in a clean condition and free from sediment. But this necessary treatment of public supplies is hardly ever carried out, or, at best, very imperfectly; so that the water, as delivered to the consumer, is often in a condition requiring treatment in the house to fit it for use. Domestic filtration is also necessary in towns and villages where there is no public supply, and in the country, where rain-water is frequently used, and the water is stored in tanks or cisterns.

A great many different kinds of filters have been devised and patented, and a great variety of substances have been used as filtering mediums. Some of these filters have great merit; others are perfectly useless for the objects intended, in some instances tending to impair the quality of the water rather than to improve it. Of this character are such filters as have a small amount of filtering material in proportion to the volume of water filtered, and which are sealed so that the necessary cleansing and renewal cannot take place. The filtering material becomes clogged in course of time, and fails to cleanse the water passed through it; it may even deteriorate the water by giving off again impurities arrested in the spaces.

#### Domestic Filters.

Among the various substances used for filtering purposes may be mentioned sand, gravel, sponge, porous stone, animal and vegetable charcoal, silicated carbon, iron ores, spongy iron, carbide of iron, flannel, and wool. According to Dr. Parkes, the best filters are either made of well-burned

animal charcoal (bone-coal), of the so-called magnetic carbide of iron, or of spongy iron. They are capable of removing almost all suspended matters, and a considerable amount of dissolved organic matters, together with a good proportion of salts, such as carbonate of lime and chloride of sodium.

The experiments made by Mr. Wanklyn with silicated carbon as a filtering material convinced him that it possesses extraordinary powers, and he therefore places it foremost amongst substances having the property of not only removing organic matter, but of actually destroying it, if

not excessive. A form of domestic filter very generally used may be illustrated by Fig. 114. Granular animal charcoal is the main body of the filtering material, but its action is assisted by the use of sponge and washed pebbles. The water passes from the receiver through a number of perforations in the top of a small chamber containing a fine sponge compactly pressed into it and overlying a bed of clean pebbles several inches in depth. The effect is to strain out all the coarser suspended matters from the water before it reaches the bed of charcoal. Without this arrangement, the surface of the bed of charcoal and the interstices between the granules would become obstructed by deposits of matter, which would soon interfere with the action of the filter. The cup containing the pebbles and sponge fits into a cylinder in the centre of the filter, and may be taken out for the purpose of cleansing by unscrewing



CHARCOAL FILTER WITH SPONGE AND PEBBLE STRAINER.

the perforated cap, which holds the sponge firmly against the gravel. The sponge and pebbles should be taken out frequently and thoroughly washed in hot water.

### The Cleansing of Filters.

Even when every care is taken, the action of filters is but temporary, and they occasionally require to be taken apart and cleansed or renewed. This is a point that does not seem to be well understood. People keep on using a filter for an unlimited time without any regard for the fact that, there is a limit to the purifying powers of all substances; and, in time the filtering material becomes so fouled as to render the water worse after filtration than before. The periodic cleansing of a filter in all its parts



is therefore very necessary. If it can be taken to pieces, the charcoal should be washed and exposed for a time in the sun, or heated (short of combustion) in an oven. Other filtering material, composed of solid substances, should be brushed and scraped and thoroughly washed.

If filters cannot be taken apart, they may be purified by passing through them from four to six ounces of a solution of permanganate of potassium, of the strength of one drachm to the pint, with the addition of a few drops of strong sulphuric acid, and afterwards two to four gallons of pure or distilled water containing a quarter to half an ounce of pure hydrochloric acid. After this has been done, three or four gallons of pure or distilled water should be poured through the filter, and it will then be ready for use.

#### **Tank Filters.**

Some filters are placed inside of tanks, so that all the water that is drawn off has to pass through them. A filter of this description is manufactured by the London and General Water Purifying Company. It consists of an earthen jar, packed with animal charcoal broken into small pieces, and it is so arranged as to be easily taken apart and cleansed. The filter is submerged in a self-filling tank of water. The water enters the filter at its base and is discharged through a pipe at the top, and is therefore filtered at the time it is drawn off. As the water passes upward instead of downward as in most filters, there is less liability of the pores becoming clogged; and, moreover, as the suspended matters usually collect on the surface of the filtering medium, with the present arrangement this disadvantage is, to a large extent, overcome.

#### **Advantages of Spongy Iron as a Filtering Medium.**

Another material which is quite extensively used in England, and which has already been mentioned as among the best filtering materials, is spongy iron obtained from ore by calcination. It is a granular substance having somewhat the appearance of charcoal. Its chief recommendation lies in the fact that it acts chemically upon the organic matter in water, and destroys it. The water dissolves a little of the iron in its passage through it, but this may be gotten rid of by filtering the water afterward through a body of prepared sand. The flow of water into the receiver is purposely slow, in order to aerate it. The Rivers' Pollution Commissioners speak in the highest terms of this material as a filtering medium. "Long experience," says Prof. Frankland, "has convinced me that spongy iron possesses many advantages over animal charcoal for domestic filtration." Fig. 115, from Prof. Nichols' *Water-supply*, shows the usual form of this filter. The water is delivered to the receiver from the mouth of an inverted bottle, which must be filled when empty. In some forms of this filter, the water is supplied by a service-pipe with a ball-and-cock attachment. The upper part B is the reservoir for water;

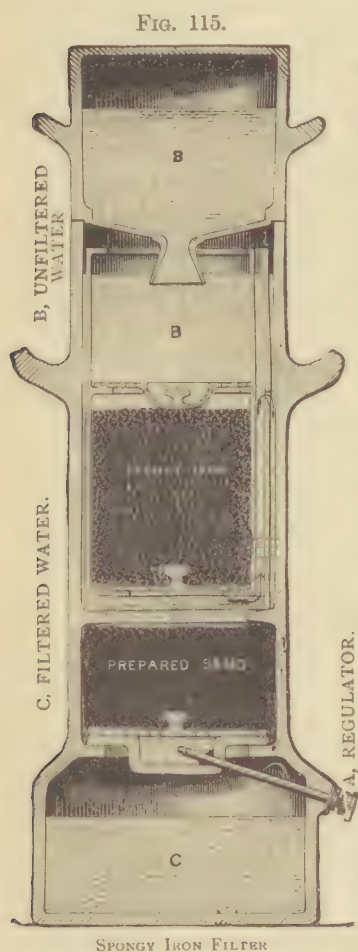
the next compartment contains the spongy iron, the next the prepared sand, and the lowest the receiver for the filtered water. The escape of filtered water is controlled by a regulator marked A.

Porous stone, unglazed earthenware, diaphragms of wool, and layers of sponges are sometimes used for filtering purposes, and they succeed very well in arresting suspended matters; but their effect upon dissolved matters, either mineral or organic, is inappreciable.

### Small Portable Filters and Faucet Filters.

Various kinds of small filters are to be had, such as syphon filters, tube filters, pocket filters, and so forth. They are useful in emergencies. The syphon filter consists of a tube with a small filter attached to one end.

The filter is placed in a vessel containing water, and the tube carried over its edge so that the discharging orifice shall be lower than the level of the water. With the pipe filters the filtering material is placed in the delivery-pipe. Pocket filters are usually made on the syphon principle. A hollow block of charcoal with a tube passing into the cavity, is a common form of such filters. Small filters are made for adjustment to faucets connected with service-pipes leading from tanks or cisterns, or delivering water from public works. Large quantities of water are frequently required for the grosser purposes of the household, and when the water is discolored by suspended matters it is objectionable, especially for washing linen. The ordinary domestic filter is not intended to supply large quantities of water, and therefore resort is had to the flannel bag, which is tied around the faucet of the hydrant, or some form of mechanical filter is used. Such a filter cannot possibly do more than strain out the suspended matters. Many of these filters are objectionable, on account of the necessity of unscrewing them from the tap when the filter requires reversing. This objection has been overcome by the invention of a filter which can be reversed without being removed from the tap.

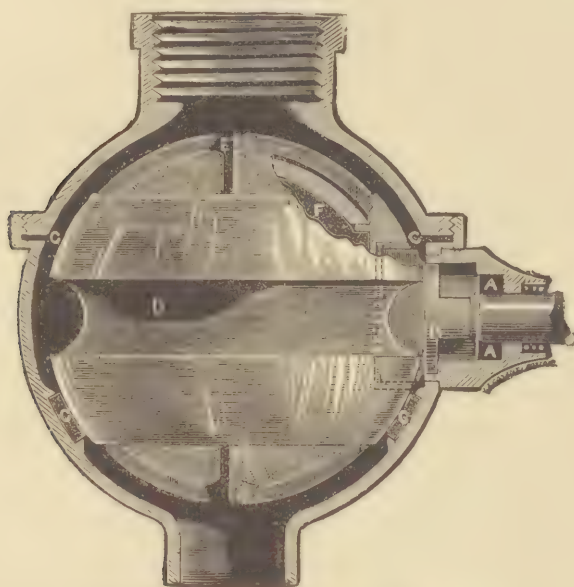


A very complete form of reversible filter, shown in Fig. 116, is described by Prof. Nichols, as follows: "The water passes through the wire gauze

E and the filtering material F. By means of a handle, the stem of which is shown in the figure, the ball may be turned over and the sediment collected at E be carried away with the first rush of water. By turning the handle half way, water may be drawn directly without passing through the filtering-ball."

There are a great many other forms of filters in the market, but none of them differ essentially in their principal features from the forms already described. The essential features of a good filter may be summed up as follows: The material of which a filter is constructed should be such as can not communicate any injurious quality to the water passing through

Fig. 116.



REVERSIBLE FILTER FOR ATTACHMENT TO A FAUCET.

it. It should be capable of removing all suspended matters, both mineral and organic, so as to render the water bright and clear; it must also be capable of being readily taken apart and cleansed, and the filtering material must be such as can be easily renewed. It is also important that the filter shall be able to remove a considerable amount of the dissolved organic matter, which most waters contain (Nichols). It must be borne in mind, that there is a limit to the purifying powers of a filter, and that the action, at best, is but temporary. The action of filters is aided by the frequent cleansing of their exposed parts; and, occasionally, the filtering material itself should be thoroughly cleaned; if this cannot be done, an occasional renewal of the material will be required.



### Effects of Impure Water upon Health.

An ample supply of wholesome water is a most important sanitary necessity. A lack of sufficient water for public and private purposes leads to local uncleanness, and uncleanness of the person, the house and its surroundings. If personal cleanliness is neglected, if the clothes go unwashed, if the use of water in the kitchen and throughout the house is restricted, if the drains are not washed out, the streets and gutters are not cleaned, and the sewers not flushed, a common condition is established, which is designated by the term filth, and filth means disease. Outbreaks of disease are very likely to occur amongst a population subjected to such disadvantages. As remarked by Dr. Simon, "uncleanliness must, without doubt, be reckoned as the deadliest of our present removable causes of disease."

Not only must the supply be plentiful, but it must be of good quality. The evidence is abundant to show that the use of impure water is a fruitful cause of disease. The effects vary with the character of the impurities. It is well known that waters containing an excess of mineral matter are very apt to be unwholesome, producing dyspepsia, diarrhœa or constipation, according to the nature of the mineral substances. The suspended, gritty matter in river-water is known to irritate the bowels, and produce diarrhœa. This is often an effect of the use of the water of the Mississippi at St. Louis, especially after a freshet. Brackish water is very apt to produce diarrhœa, especially among young children. Goitre has been connected with the presence of mineral ingredients in water. Water containing an excess of vegetable matter is capable of conveying disease. Serious outbreaks of diarrhœa have been traced to this cause. Ague is not infrequently produced by the use of marsh-water. The violent outbreak of diarrhœa among the inhabitants of a district of country separated by the border line between Virginia and Kentucky, which occurred in the latter part of the summer of 1884, was supposed to have been due to presence of an excessive quantity of mineral salts in the water of wells that had been greatly lowered during a season of prolonged draught.

Some waters in their natural condition are thus capable of producing sickness. But a much graver importance is attached to the influence of water polluted by the waste matters from habitations, or by the sewage of towns and cities. The presence of putrescent animal matter in drinking-water, which has become polluted by the soakage from cess-pools or leaky drains, or by the discharges of sewers and drains, gives to it a dangerous quality, which is often the cause of disease in its most virulent form. It is true that chemical analysis often fails to point out the exact connection between impure water and disease, so subtle, oftentimes, are the agents concerned in its production; but this is no proof

that such a relation does not exist, as the connection of certain specific diseases with the use of impure water has been over and over again established by other evidence of the most conclusive kind. And it seems probable that, as more precise investigations proceed, the frequency and importance of this mode of origin of disease will be established beyond question.

### **Diseases likely to be Produced by Impure Water.**

Among the diseases which have been ascribed to impure water may be mentioned diarrhœa, dysentery, typhoid fever and cholera.

Diarrhœa is a very frequent consequence of drinking impure water. It prevails most extensively in the summer and autumn months, and is particularly fatal to children and old people. It is often attributed to the use of unripe fruit, and this is no doubt a common cause; but it is quite as frequently produced by the use of polluted water taken alone or mixed with milk.

### **Impurities Causing Diarrhœa.**

Animal matter, especially of fecal origin, vegetable matter and some mineral matters, may all act, under certain circumstances, as a cause of this disease.

Suspended mineral substances, such as particles of clay and gritty mineral matter, which are frequently contained in river-water, irritate the bowels and often cause diarrhœa, especially in persons not accustomed to the water. The hill-diarrhœa of India is attributed to fine scales of mica suspended in the water. Many dissolved mineral salts cause diarrhœa. Among these may be mentioned the sulphates of lime and magnesia, and the chloride of sodium when in excess. This latter constituent of brackish water causes it to disagree with most persons, particularly when chloride of magnesium is also present. Suspended vegetable matter may also cause diarrhœa.

Water impregnated with animal matter, especially in the form of sewage, is a very common cause of diarrhœa. Numerous well-authenticated cases have been recorded in which this disease has followed the use of water polluted by sewage matter. Dr. de Chaumont mentions a severe outbreak of diarrhœa occurring at a school at Winchester, which was traced to the bursting of a drain into a well. Dr. Gibb mentions a series of cases of violent diarrhœa produced by water contaminated with sewage which had got into a cistern. Suspended animal substances washed into shallow wells during heavy rains have caused diarrhœa, as in the case at Prague, in 1860, which is cited by Dr. Parkes. People who drink river-water heavily charged with organic matter, principally sewage, are subject to attacks of the disease.

Water that has absorbed sewer-gas,—a not unlikely occurrence when the overflow-pipe of a cistern communicates with a drain or sewer,—will

cause diarrhœa. Dr. de Chaumont mentions such a case occurring in a public institution at Southampton, and Dr. Greenhow cites a similar case recorded in Mr. Simon's report to the Privy Council in 1860.

The presence of the bodies of dead animals in water, and putrefying there, will cause intestinal derangement. Such a case occurred in the writer's experience, in which every member of a household was affected with violent diarrhœa, due to the presence of the decomposing body of a rat in the well. When the putrid matter had been removed and the well cleaned, the disease promptly disappeared without a recurrence.

### **Impure Water a Cause of Dysentery.**

The fact that dysentery is caused by impurities in water is so well established that it is hardly necessary to mention cases in way of proof. To mention the kinds of impurities that produce this affection would be to repeat what has already been said with regard to the kindred affection, diarrhœa. One prominent point should be borne in mind, namely, that the stools of dysenteric patients can propagate the disease; and this fact may, in part, account for the obstancy with which the disease prevails in a locality when once it has obtained a foothold, in all probability the accidental passage of the evacuations into drinking water having something to do with the spread of the disease.

### **Enteric or Typhoid Fever Propagated by Polluted Water.**

Since the opinion was first advanced, that typhoid fever can be communicated by impure water, evidence of the strongest character has been accumulating which goes to prove that not only is this disease spread by polluted water, but that this is one of the most frequent modes of its propagation. The essential factor in this mode of propagation is that the impurity shall contain fecal matters. According to the majority of observers, the fecal matters must have a specific character, that is, such as can only be derived from the bowel evacuations of persons suffering from the disease. Sir William Jenner, an undoubted authority, remarks, in adverting to this subject, "that the spread of typhoid fever is, if possible, less disputable than the spread of cholera by the same means (impure water). Solitary cases, outbreaks confined to single houses, to small villages, and to parts of large towns—cases isolated it seems from all sources of fallacy—and epidemics affecting the inhabitants of large though limited localities, have all united to support by their testimony the truth of the opinion that the admixture of a trace of fecal matter, but especially the bowel excreta of typhoid fever, is the most efficient cause of the spread of the disease, and that the diffusion of the disease in any given locality, is limited or otherwise, and just in proportion as the dwellers of that locality derive their drinking water from polluted sources."



**Enteric or Typhoid Fever from Excrement in Drinking Water.**

The weight of evidence seems to support the opinion, that typhoid fever is due to a specific poison which is chiefly to be found in the alvine passages of persons suffering from the disease; that it is mainly propagated through the air and through water, but that this latter mode of dissimulation is much more certain. Water contaminated by ordinary fecal matter may produce diarrhœa, but it will not cause typhoid fever; for the production of this disease, a specific poison must be present.

There are a great number of cases on record which tend to prove the connection of typhoid fever with excremental pollution of drinking water. The soakage from soils saturated with sewage and excremental matters is a very common source of pollution of well-water. This is not surprising when we consider how little precaution is taken in preventing the filth from cesspools and drains and from defiled places about houses from soaking into the soil. Once in the soil, these foul matters readily gain access to the water of wells used for drinking purposes. River-water receiving the sewage of towns and cities has been the means of spreading the disease. Sudden outbreaks of typhoid fever have been caused by the eruption of sewage into wells from a break in a drain or cesspool, or from a soil in which the matter had been gradually accumulating. It may be remarked in this connection, that when the poison is imbibed with water the incubative period is usually short; and, as Dr. Budd remarks, this mode of infection is, in all probability, much more certain than when the poison is conveyed through the medium of the air.

**Instances of the Propagation of Enteric Fever by Polluted Water.**

The outbreak of fever that occurred at Cowbridge, in Wales, in 1853, presented this fact, that out of ninety or one hundred persons who attended a ball at the town inn, more than one-third were shortly afterward attacked with fever. There was good reason for supposing that the water used on that occasion was contaminated, although no chemical examination was made.

An outbreak of typhoid fever at the Convent of Sisters of Charity at Munich, in 1860, was traced to the defilement of wells by sewage containing typhoid evacuations. Out of one hundred and twenty inmates thirty-one took the disease, and four of them died. It is important to state that the disease disappeared soon after the use of the water was discontinued.

Dr. de Chaumont states that, in a school at Hants, diarrhœa prevailed on account of ordinary sewage getting into the well; but after a case of typhoid fever was contracted outside, this disease spread rapidly and fatally through the school.

An interesting case, reported by Dr. Allbutt, and quoted by Dr. Wilson, is that which occurred at Bramham College, Yorkshire, in March, 1869: "It appears that two of the pupils were laid up with enteric fever in February, but circumstances showed that they must have contracted the disease before their arrival at Bramham. Towards the end of March nineteen fresh cases occurred, and all of them about the same time. This sudden outbreak clearly pointed to some common cause which must have been in operation, and it was then discovered that the well used to supply drinking-water was contaminated by soakage from a soft-water tank, into which sewage matter had passed from a broken water-closet pipe. The discharges of the first two patients had also passed into this tank, and had, doubtless, been the cause of the outbreak. Another important fact connected with this outbreak was the distribution of the disease amongst the pupils, it being confined to those who drank water, while those who drank beer escaped. As the same water was used for cooking purposes, it would thus appear that the poison must have been destroyed by boiling."

Dr. Allbutt also records a case which occurred at Ackworth, in 1870, where the water of a well polluted with sewage caused an outbreak of the disease soon after its special pollution by discharges of a patient who had been brought home while suffering from the fever.

### **Specific Outbreak of Typhoid Fever at the Village of Nunney, Eng.**

Dr. Parkes considers the case of the village of Nunney, recorded by Ballard, as furnishing very strong evidence in favor of the origin and propagation of the disease by a specific poison. The inhabitants of this village had been in the habit of using polluted water for years without fever: but after a case had come into the village, and the discharges from this person were washed into the stream from which the drinking-water was obtained, a violent outbreak of fever occurred. "Between June and October, 1872, no less than seventy-six cases occurred out of a population of 832 persons. All those attacked drank the stream-water habitually, or occasionally. All who used filtered rain-water or well-water escaped, except one family who used the water of a well only four or five yards from the brook." Dr. Parkes further remarks, "that the case seems quite clear—first, that the water caused the disease: and secondly, that though polluted with excrement for years, no enteric fever appeared until an imported case introduced the virus. Positive evidence of this kind seems conclusive, and I think we may now safely believe that the presence of typhoid evacuations in the water is necessary. Common fecal matter may produce diarrhoea, which may be febrile, but for the production of enteric fever the specific agent must be present."

### **Typhoid Fever Communicated by Adulterated Milk.**

Typhoid fever is not unfrequently communicated by milk, adulterated with water taken from an impure source. Since Dr. Ballard published his report of an epidemic of typhoid fever at Islington, in 1870, attention has been directed to this source of dissemination of disease, and the result has been a record of at least one hundred epidemics alleged, upon reliable grounds, to have been traceable to milk which had become specifically contaminated, mainly by the addition of polluted water. Boiling milk will confer immunity from infection conveyed by it, and this means of prevention should be employed when the supply is derived from an uncertain source.

### **Propagation of Cholera by Means of Polluted Water.**

Cholera is an infectious disease, native to India, but occasionally appearing in other parts of the world, following in the track of communication with infected centres. Its cause is now believed to be a specific living organism, the so-called *Comma bacillus*, which is chiefly to be found in the bowel evacuations of persons suffering with the disease. The infecting matter must gain entrance into the intestinal canal to produce cholera in another. This may take place through the medium of the air or food, but drinking-water is a very frequent and most common medium of dissemination. Since Dr. Snow first announced his views, in 1849, respecting the propagation of cholera by polluted water, based on facts gathered at Horsleydown, Wandsworth, and other places, and subsequently confirmed by evidence in the famous and conclusive Broad-street pump case, other and abundant evidence of the most unequivocal character has been collected, which goes to substantiate this opinion; and now many of the former opponents of the theory, among them Pettenkofer, are forced to admit that this mode of conveyance of cholera does actually occur.

The evidence from India, the home of this disease, is, in the main, confirmatory of this view. Drs. MacNamara, Townsend, and Cleghorn, who have devoted special attention to the subject of cholera, have all furnished strong proof of the fact that the dissemination of the disease is largely dependent on the use of impure water. It is a significant fact, that, in that country, whenever the use of polluted water has been abandoned, and a pure supply substituted, the disease has at once diminished. This was notably the case in the city of Calcutta, which formerly procured its supply of drinking-water from open tanks, and, to some extent, from the Hoogly river, both of which sources were exposed to pollution. After an improved supply had been procured, there was a marked diminution in the cases of cholera among all classes of the inhabitants. As a further confirmation of the above statement, Dr. de Chaumont cites the following facts: "In Russia the occurrence of cholera



in the dead of winter has been explained by the practice of using melted snow, on which all house-slops and excreta are thrown, for drinking and cooking purposes. In Silesia, certain towns have never suffered from cholera, the one common condition being that the water-supply is from a distance, and cannot be contaminated. Dantzic and Königsberg used to suffer equally: Dantzic obtained a new and pure water-supply, and ceased to suffer; Königsberg continued with the old supply, and continued to suffer."

Dr. Ballots' report on the spread of cholera in Holland shows, that, in all those towns in which rain-water alone was drunk, there were either no cases of cholera, or very few single cases, and these were supposed to have been imported: while, on the other hand, where the water-supply was derived from the canals and wells, both highly polluted with sewage, the disease prevailed. "When places affected by the cholera were supplied with pure water, instead of the vitiated water, the disease disappeared." During the last great epidemic in that country, the city of Amsterdam, which is supplied with rain-water carefully collected and distributed, had only four deaths per 1,000, while in other cities and towns supplied with the water from the Polders, or from the canals, the rate of mortality was 16.8 to 17.7 per 1,000.

Prof. Chandler mentions an outbreak of cholera that took place in a village near the Central Park, New York, in 1866, which was traced to the polluted water of the village well. In the celebrated case of the Van Brunt-street pump, Brooklyn, which was polluted by sewage, the disease spread among the fifty families supplied by it, until the use of the water was prohibited.

The fact that the death-rate from cholera in districts supplied with impure water has been very great, while in other districts situated in the same locality and otherwise placed under similar conditions, except that the water-supply was from a pure source, it has been comparatively slight, is strong evidence in favor of the propagation of the disease by the medium of the water-supply. Dr. Simon has shown, that, in London, those houses supplied with polluted water drawn from the river furnished a death-rate from cholera equal to thirteen per 1,000; while other houses, situated under quite similar circumstances, except that they were supplied with pure water, furnished a death-rate of only 3.7 per 1,000. Similar examples are furnished by Frankland in the case of London, by Schiefferdecker in the case of Königsberg, and by Parkes in the case of Berlin.

#### **Summary of Facts in Proof of the Propagation of Cholera by Means of Polluted Drinking-water.**

Other evidence similar to that already presented might be brought forward to prove the origin of cholera through the agency of polluted

drinking-water, but it is unnecessary to multiply cases. The facts already in our possession may be summed up as follows: 1. Facts which go to prove the direct connection between local outbreaks and the use of drinking-water contaminated by sewage. 2. The freedom of towns from cholera during its general prevalence, when such towns are provided with a water-supply free from sewage contamination; while other towns in the same locality and presenting similar conditions, but supplied with impure water, have suffered greatly. 3. The fact that places which were ravaged in former visitations have escaped at its subsequent returns, after the introduction of pure drinking-water. 4. The fact of the cessation of outbreaks following the disuse of polluted water, and the introduction of a pure supply.

### **The Spread of Cholera, and How to Prevent it.**

There is no proof that cholera may be produced by water uncontaminated by cholera evacuations, though it is probable that the use of water containing organic impurities, by causing a constant tendency to diarrhoea, and by lowering vitality, predisposes to this disease. As Dr. George Wilson remarks, "this much, however, appears certain that whenever cholera evacuations make their way into drinking-water, we may expect to find the disease burst forth with the greatest virulence and fatality amongst those who use the water, and that, indeed, the endemic area will approximate, with remarkable closeness, to the limits of the district which it supplies." Water specifically contaminated by cholera evacuations (most commonly due to improper disposal of sewage) being the most prominent cause of the propagation of this disease, it may be stated with equal assurance that a town or community having a supply of pure water and a perfect system of drainage need have no dread of an invasion of cholera, even though the disease has been brought into the place. As the disease may be spread, to a limited extent, by other agencies, such as the air, food, soiled hands, and so forth, it may not be out of place to remark, that the most effectual means of prevention lies in the complete destruction of the infecting matter at its very issue from the body. If this is done (one drachm of corrosive sublimate, with an equal quantity of common salt, dissolved in one gallon of water, is one of the most efficient disinfectants for the purpose), we prevent the infecting material from reaching the intestines of other persons, and prevent them from getting cholera.

### **Other Diseases Propagated by Impure Drinking-water.**

Fever and ague is another disease that appears to be communicated by impure water. The water of marshes and ditches containing a large amount of vegetable debris is known to have produced this disease. Water rendered impure by the presence of large quantities of the sul-

phate of calcium, chloride of calcium, and the magnesian salts, causes dyspepsia, a term embracing the symptoms of loss of appetite, distress in the region of the stomach, nausea and constipation, with occasional diarrhœa. Iron when present in sufficient quantity to give a distinct taste to water, often produces dyspepsia, with headache and languor. Persons may, however, become accustomed to such water, and after a time experience no ill-effects from its use.

Amongst other diseases which have been attributed to impure drinking-water may be mentioned sore throat, diphtheria, scarlet fever, erysipelas, and the "low fever" of country districts.

Parasites may gain entrance to the body through the agency of drinking-water, as for example, the tape-worm and the round-worm. Cases have been recorded in which the round-worm gained entrance to the body from water taken from a filthy pond and from shallow dip-wells.

Poisoning from lead, copper, zinc, arsenic, and so forth, has occurred from the use of water into which these metals have been discharged with the refuse of trades, or by the water dissolving the metal in passing through pipes, or while being stored in cisterns. The circumstances under which such poisoning is apt to occur have already been alluded to in previous pages.

### Sanitary Examination of Water.

The sanitary examination of water is undertaken with the object of ascertaining whether the water contains any dissolved or suspended matters that are likely to be injurious. Such an inquiry involves the knowledge of microscopic investigation and chemical analysis, methods which require special training for their successful employment. One or more simple tests, however, may be mentioned, which may be carried out without any special knowledge of chemistry. If chlorine is present in considerable quantity, it is due to impregnation of sea-water or to strata containing chloride of sodium or calcium, or to an admixture of liquid excrement of men or animals. If not due to the first mentioned sources, its presence should give rise to suspicion of sewage impregnation. If a few drops of a solution of nitrate of silver containing a little nitric acid be added to the suspected water, a slight haze will be produced if only a little chlorine is present; but if there is much, a marked turbidity will result, which will change to a lead color. A solution of permanganate of potassium may be used to determine the presence of organic matter. If a few drops of such a solution is added to the water it produces a pinkish color, which should remain sometime, if the water is reasonably pure. If the color rapidly disappears, it indicates excess of organic impurity, probably animal organic matter. Nichols mentions a test for sewage contamination, proposed by Heisch, which is as follows: "Place some of the water—say half a pint—into a clean, colorless glass-stoppered



bottle, add a few grains of white sugar, shake until the sugar has dissolved, and leave the bottle freely exposed to the light in a warm room for a week or ten days. If the water becomes turbid, it is open to suspicion of sewage contamination; if it remains clear it is probably safe."

If these tests are carefully performed, they may furnish clues for a more reliable examination; but chemical tests in the hands of unpracticed persons are not to be depended on. Some information of the quality of a water may be obtained from an examination of its physical characters. Its smell, taste, color, and transparency will give some indications of the quality. A good water should be perfectly clear and contain no suspended matter or sediment. It should be colorless, and free from odor or taste. It should be bright and sparkling, showing that it is well aerated; and it should have a certain degree of softness, so that cooking operations can be properly performed. It should be remarked, that a water may possess all these qualities and yet not be free from danger. On the other hand, it may be said that if all these qualities be present in a water, the chances are greatly in favor of the water being pure and wholesome.

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## CHAPTER V.

### THE REMOVAL OF REFUSE MATTERS.

THE proper removal of refuse matters, solid and liquid, from habitations and their vicinity, or, in other words, thorough cleanliness in and about the dwelling, is indispensable to healthy life. Universal experience attests the fact, that the disregard of this foremost feature of sanitary administration is the potent cause of a vast excess of deaths from diseases which belong to the preventable class. "It has been among the oldest and most universal of medical experiences that populations living amid filth, and within direct reach of its polluting influence, succumb to various diseases which, under opposite conditions, are comparatively or absolutely unknown." The great waste of life by disease in the middle ages was dependent, in large part, on the barbarous and inefficient modes of disposal of the excreta of men and animals. There was not then the exact knowledge of the various channels of indirect and subtle influence

through which filth exerts a wide and destructive power, which we possess at the present day; yet, notwithstanding our advanced knowledge, uncleanness may still be regarded as "the deadliest of our present removable causes of disease."

### Mode in which Filth Produces Disease.

The accumulation of organic refuse matters in and about houses leads to the pollution of the air, water and soil. The most dangerous agencies in filth are not the offensive gases given off by the putrefactive decomposition of organic matter, though these may be hurtful in proportion to the degree of their concentration. It is the septic particles or ferments which are associated with putrefactive changes in organic matter, and the subtle poisons of specific diseases which may be frequent incidents to decomposing refuse, that give to filth its most mischievous quality. These disease-causes are most commonly associated with nuisances of the excremental sort, and the prevalence of fatal disease in filthy neighborhoods is in all probability due to this filthy mode of infection. Typhoid or enteric fever is very commonly spread in this disgusting manner. "The experience is, not only that privies and privy-drainage, with their respective stinkings and soakings and the pollutions of air and water which are thus produced, have in innumerable instances been the apparent causes of outbreaks of enteric (typhoid) fever, but further, that they have seemed capable of doing this mischief in a doubly distinctive way: first, as though by some aptitude which other nuisances of organic decomposition, though perhaps equally offensive, have not seemed equally or nearly equally to possess; and secondly, as though this specific property, so often attaching to them in addition to their common septic unwholesomeness, were not, even in them, a fixed property. The explanation of this experience, the explanation of the frequent but not invariable tendency of privy nuisances to infect with enteric fever, has seemed to consist in the liability of such nuisances to carry with them, not invariably, but as frequent accidental adjuncts, the "specific" contagium of any prevailing bowel affection: for, presumably, the privies of a population receive, with various other things, the diarrhoeal discharges of the sick: and it has long been a matter of fair pathological presumption, that in any specific diarrhoea (such as eminently is enteric fever) every discharge from the bowels must teem with the contagium of the disease." After referring to other diseases that owe their distribution to this same filthy method of infection, such as cholera, dysentery, and allied affections, which have the seat of their infective changes in the intestinal canal, Dr. Simon further remarks, "it would thus seem probable that air and water, having in them the taint of human excrement, must often carry with them, whithersoever they pass, the seeds of current morbid infections."

But the category of diseases attributable to decomposing organic refuse matters is not limited to that dangerous class of affections which are connected, in their origin, with a specific poison discharged with the intestinal evacuations of the sick; a poison which is capable of retaining its infective property, and, perhaps, of multiplying, outside the human body, and of being successively communicated from man to man through the intermediary channels of polluted air, food and water. There are other diseases—and the number is by no means insignificant—which are found to prevail in filthy localities, and which are due to a poison or poisons, the so-called septic ferment or ferments, generated outside the human body in the putrefactive decay of organic matter. This poison, which is developed exterior to man, amid conditions of filth, is capable, under favorable circumstances, of producing diseases anew, which are then communicable from one person to another. Presumably, this common infection, which has its lurking places in fouled air or fouled water, has always a hurtful tendency; but the healthy human body may be able to resist its influence to a limited extent. Against these subtle infections, which are supposed to pervade the air of crowded localities, the so-called antiseptic treatment in surgery and midwifery are chiefly directed. There is good reason for believing that those serious infections to which persons having accidental wounds or surgical wounds, and women in the lying-in state, are so frequently subject, which are comprehended under the terms erysipelas, pyæmia (pus in the blood), septicæmia (putridity of the blood), and puerperal fever, have a very intimate connection with “filth-inoculation from the air.”

The gradual and continuous operation of this same cause has been conceived by some as not unlikely to give rise to conditions of the system leading eventually to the establishment of consumption and general tubercular disease.

With regard to other diseases, such as sore throat, diphtheria, pneumonia, and so forth, which have been attributed to the agency of filth, there does not exist the same precise knowledge.

Without specifying further, we may advert to the broad fact, which has been abundantly substantiated by a vast experience, that among masses of population living under the domination of filth, the mortality, especially amongst children, who seem to be more susceptible to its influence, is far greater than it should be, and this excess cannot be accounted for by any other explanation than that it is the effect of filth.

#### **Absolute Cleanliness the Essential Preventive of Disease.**

Such being the dangers incident to filth, it becomes a matter of the highest importance that all foul refuse matters shall be promptly and continuously removed from the vicinity of human habitations, so that neither air, water nor soil shall be made impure. This necessity exists



everywhere, but it is particularly urgent where a population is massed upon a small area, as in towns and cities, where, from the aggregation of filth, nuisances of this character become far more numerous and far more dangerous than they can possibly be among a population spread over a large area, as in rural districts. Unfortunately, there are so many difficulties in the way of a rapid and complete disposal of the waste matters of a population, difficulties in public administration and in private management, that this foremost principle of domestic sanitation is never fully carried out, and the consequence is an excess of preventable disease arising from polluted air, water and soil, due to the unnecessary presence of filth in its various forms.

### **Chief Forms in which Filth is Encountered.**

The principal forms in which filth is apt to be found about dwellings are admirably described by Dr. John Simon in his reports to the Local Government Board. He says: "There are houses, there are groups of houses, there are whole villages, there are considerable sections of towns, there are even entire and not small towns, where general slovenliness in everything which relates to the removal of refuse matters, slovenliness which in very many cases amounts to utter bestiality of neglect, is the local habit; where, within or just outside each house, or in spaces common to many houses, lies for an indefinite time, undergoing fetid decomposition, more or less of the putrefiable refuse which house-life, and some sorts of trade-life, produce: excrement of man and brute, and garbage of all sorts, and ponded slop-waters; sometimes lying bare on the common surface; sometimes unintentionally stored out of sight and recollection in drains or sewers which cannot carry them away; sometimes held in receptacles specially provided to favor accumulation, as privy-pits and other cesspools for excrement and slop-water, and so-called dust-bins receiving kitchen refuse and other filth. And with this state of things, be it on large or on small scale, two chief sorts of danger to life arise: one, that volatile effluvia from the refuse pollute the surrounding air and every thing which it contains: the other, that the liquid parts of the refuse pass by soakage or leakage into the surrounding soil, to mingle there, of course, in whatever water the soil yields, and in certain cases thus to occasion the deadliest pollution of wells and springs. To a really immense extent, to an extent indeed which persons unpracticed in sanitary inspection could scarcely find themselves able to imagine, dangers of these two sorts are prevailing throughout the length and breadth of this country, not only in their slighter degrees, but in degrees which are gross and scandalous, and very often, I repeat, truly bestial. And I state all this in unequivocal language, because I feel that, if the new sanitary organization of the country is to fulfil its purpose, the administrators, local and central, must begin by fully recognizing the real state of the

case, and with consciousness that in many instances they will have to introduce for the first time, as into savage life, the rudiments of sanitary civilization.

"A second point, which equally with the above needs to be recognized by all who are responsible for the prevention of filth-diseases, is, that filth does not only infect where it stands, but can transmit its infective power afar by certain appropriate channels of conveyance; that, for instance, houses which have unguarded drainage-communication with cesspools or sewers may receive through such communication the same filth infections as if excrement stood rotting within their walls; and that public or private water-reservoirs or water-conduits, giving accidental admission to filth, will carry the infection of the filth whithersoever their outflow reaches. Thus it has again and again happened, that an individual house, with every apparent cleanliness and luxury, has received the contagium of enteric fever through some one unguarded drain-inlet; or that numbers of such houses have simultaneously received the infection, as an epidemic, in places where the drain-inlets in general have been subject to undue air-pressure from within the sewer. And thus equally on the other hand it has again and again happened that households, while themselves without sanitary reproach, have received the contagium of enteric fever through some nastiness affecting (perhaps at a considerable distance) the common water-supply of the district in which they are."

### **Common Sources of Excremental Pollution of Air and Water.**

Nuisances arising from the improper disposal of refuse matters may be traced to three or four principal causes: to the want of provision or to defects of public sewerage; to defects of house-drainage; to defects of privies or other receptacles for the storage of excrement, and to defects of removal of kitchen garbage and other refuse. In the absence of a system of underground conduits for the removal of excreta and house waters, some plan is adopted by which a greater or less amount of these matters is retained upon the premises, where, by decomposition on the surface or by soakage into the ground, nuisances of a very objectionable character are very apt to be created. The slop-waters and other liquid filth are turned into the open gutters, if not disposed of in some way or other on the premises. Considering the putrifiable nature of this material, it is not surprising that channels intended only for the passage of rain-water should in time become intolerably foul, and fill the atmosphere with ill-smelling and pernicious effluvia. Without sewers, some one of the many plans of disposing of excreta upon the premises is adopted, according to the convenience of the property owner. In some towns, the manner of storing and disposing of fecal matters is subject to municipal regulation; but even then the evils of this system are only in part prevented.

### Faults of Sewerage.

Sewers are so often badly constructed, badly ventilated and carelessly supervised, that they become in themselves most dangerous conveniences. Sewers should be made water-tight, and so constructed that the sewage shall have a continuous and uninterrupted flow to the outfall; that is, they should be self-cleansing. These results are seldom obtained in practice. In consequence of these defects, liquid matter in considerable amount oozes through the porous walls, and through cracks and joints in the brick-work, and saturates the soil below with impurities. The stagnation of sewage not only favors the escape of liquid matter, but causes the deposit and accumulation of its solid constituents, and thus primarily defeats the very object for which the sewers are intended. They, in fact, become converted into cesspools of huge proportions. The pestiferous vapors generated within their filthy walls are discharged upon the public ways through untrapped gulleys, and through openings in the street designed for ventilation. Whatever may be said of the danger of sewer-gases thus continually discharged into the open air, it is not comparable to the risk to which the inhabitants of houses which drain into the sewer are exposed. Through defects in the drainage arrangements, the sewer-air may gain direct access to such houses, the intercourse being greatly promoted when there has been neglect to provide intercepting traps and soil-pipe ventilation. To reduce this risk to its lowest degree, sewers should be well constructed, perfectly ventilated, and should permit of a free and continuous flow to the outfall of all matters discharged into them from the very moment of entrance. The safety of houses connected with sewers that do not fulfill all these conditions cannot be ensured, no matter how perfect may be their drainage arrangements. Most houses have very imperfect drainage arrangements, and therefore the reason is all the stronger why sewers, radically defective, should be abolished without delay, and a well-planned system take their place.

### Faults of House-Drainage.

Nuisances caused by faults of house-drainage are of a serious character, because the effects are exerted directly within the house. The modern plan of disposing of solid and liquid excreta and the bath and kitchen waters by means of a system of pipes connected with a common drain leading into the public sewer or a cesspool, exposes the inmates of the house to dangers to health, incident to faults in the drainage arrangements themselves, and to a close connection with the sewer or depository of sewage. Bad materials, inferior apparatus, and unskillful construction may defeat the object for which the system of drainage is intended, so that the air of the house and the soil upon which it stands become contaminated by the escape of gases from foul waste- and soil-pipes, and by the leakage of liquid filth through disjointed pipes. Water-closets, baths,



washstands and sinks in the interior of the house, often within the bedrooms or in their close neighborhood, are brought in more or less direct communication with sewers, and are often so many outlets for the foul vapors that collect within them. The ignorant or negligent arrangement of overflow-pipes, the want of proper traps, traps allowed to become dry by disuse, the careless misplacement of traps of the movable kind, afford so many ways for the entrance of sewer-gases, an accident which is all the more certain to occur when there has been a neglect to provide ample soil-pipe ventilation. Water-closets of bad design and construction, which retain the filth and become obstructed from this cause as well as from insufficient flushing, are a constant source of offensive odors. Another danger arises from injudicious connection of the service-pipe with the water-closet for flushing purposes. It is a very common occurrence, even with the constant system of water-supply, as has been explained in the previous chapter, for the supply to be cut off at intervals, during which it is possible and highly probable that fluid filth will be drawn into the service-pipe and defile water that may be immediately afterward used for drinking purposes.

House-drains, which are very frequently located immediately under the house, may pollute the soil and foundations, should any deficiency exist in their construction. By unskillful construction or by subsequent careless usage or want of repair, the sewage of the house, instead of passing freely and continuously into the sewer, becomes effused into the basement through broken or disjointed pipes. In consequence of the escape of the liquid portions of the sewage, obstructions form, which, in time, block up the pipe. This occurrence is frequently not detected until, after an unusual discharge of liquid which the saturated soil is not able to quickly absorb, the sewage makes its appearance at the lowest fixture in the house by an overflow. Where water escapes, gases will also escape, and through the same breaks and misplaced joints sewer-air will escape into the soil, adding to the impurities in the soil, which in the form of foul air are drawn directly into the basement, and thence distributed all over the house by the ascensional force of heated air.

#### **Faults of Storage of Excrement.**

But of all the sources of excremental pollution, none prevails to a greater extent, is more dangerous in its effects upon health, and more discreditable to sanitary government, than depositories of filth of the accumulative sort. The custom of accumulating excreta for an indefinite length of time in pits located within a convenient distance of the house has nothing to recommend it, but very much to disparage it. Notwithstanding the evils which are inseparably connected with the storage of human excrement in the vicinity of habitations, evils which have been pictured in the most unmistakable colors and condemned without measure, the

privy-system continues to be the system most commonly in use in villages, towns, and even in large cities having the facilities of water-carriage for the prompt removal of sewage. Even where sewers are at command, people very often make use of the cesspool as an intermediary catch-pit between the house-drain and the sewer, as if loth to relinquish a very ancient practice which has nothing to commend it but antiquity.

Under the most favorable circumstances, the storage of excrement in close proximity to dwellings must be regarded as an evil. The chief objections to it, however, arise from bad construction and bad management, through which common faults pollutions of air and the water-supply very frequently occur.

#### **Conditions to be Observed in the Storage of Excreta.**

Every out-door receptacle for excreta, of whatever description, should be so designed, constructed, and managed as to prevent the contamination of air, water and soil, both in the place itself and during the process of removal of its contents. It should be constructed of unabsorbent, impermeable materials, and be made water-tight, so that the material itself shall not become permanently foul, nor permit the escape of any fluid whatsoever. It should be so limited in size as to prevent undue accumulation of offensive matter; its use should be restricted to fluid and solid excreta, and substances applied for their absorbent and disinfectant qualities; and the removal of the accumulations should take place at short and regular intervals, and with the least conceivable agitation of the mass and with the least exposure to the air, so that the possibility of causing a nuisance in this part of the administration of the system shall be reduced to the lowest degree.

#### **Common Methods of Disposal of Excreta.**

In practice these conditions are very frequently set at naught. In the country it is not uncommon to find no proper receptacle whatever, the fecal matter and urine being deposited on the surface of the ground. The liquid parts are washed over the surface or soak into the ground, while the solid filth is only removed when by its bulk it becomes an inconvenience, or when there arises an agricultural demand for the material.

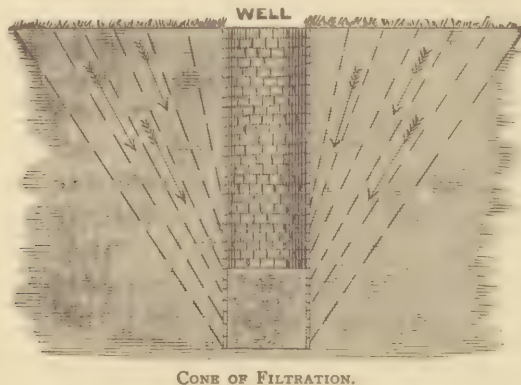
A simple hole in the ground, with perhaps a brace to keep the walls of earth in place, is the kind of receptacle quite often used in villages and country towns, and, to some extent, in cities. A cask or hogshead is sometimes fitted in an excavation in the ground, the earth at the bottom being left bare on purpose to absorb the liquid filth. A more substantial structure is made by building the walls of brick or masonry laid dry, the bottom being formed in the same manner or left bare, the object of this manner of construction being to favor the escape of all liquid matter, so

that frequent cleansing will not be required. Privy-wells of this description are sometimes dug to a great depth until a porous bed, such as gravel, has been reached, which will aid the escape of fluid filth. Such wells are very common in cities, and it is not unfrequently the case that their location is close to foundation walls or beneath the building. If a porous soil can be tapped, it is not unusual to test its absorbent powers by discharging the drainage from the water-closet and bath into it; and this mode of drainage is persisted in until the pores of the soil become obstructed by solid material and the well fills up, when it is abandoned and another well dug, or the well is tapped by a pipe leading to the sewer, which is used thereafter to carry off the excess of liquid filth. Where such a mode of disposing of the excreta of a population prevails (and it is by no means uncommon), not only the soil, but the entire bed of water beneath the town, becomes polluted, and the consequences of using such water for drinking purposes will be most serious. For this reason no wells for drinking-water should be permitted in places where the soil is made use of for sewage removal, no matter how much care has been exercised in sinking the wells. Typhoid fever and cholera, when present in the locality, are most likely to spread through such channels of polluted water.

#### Dangers from Cesspools.

In order to show how very readily a leaching cesspool may pollute the water of a well upon the same premises, Prof. Kedzie has made use of two diagrams, one of which represents what he calls the *cone of filtration*, Fig. 117, the other the *cone of pollution*, Fig. 118. In the case of the well, the base

FIG. 117.



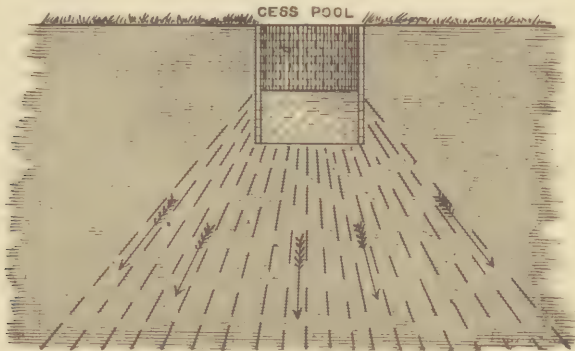
of the cone is a circle at the surface of the ground, the centre of which is the well, and the apex of the cone is the bottom of the well. With the cesspool the apex of the cone is at the centre of the ground over the cesspool, while its base is at the ground-water at an indefinite distance below the surface of the ground. When these cones intersect one another, the water in the



well will become polluted. This demonstration is not strictly accurate, but it serves to illustrate, in a general way, the dangers which may arise from a close proximity of well and cesspool.

The cesspool with an overflow-pipe connected with the sewer, and used for an out-door convenience and as a receptacle for all the sewage of the house, is another nuisance of a very bad description. The excess of liquid escapes by the outlet-pipe, but no complete discharge of sewage, ever takes place. At each discharge of sewage or of kitchen or bath

Fig. 118.



CONE OF POLLUTION.

water, the putrifying matters in the cesspool are disturbed and agitated, and fetid gases are liberated, and perhaps drawn into the house, through the untrapped waste-pipes. The outlet-pipe leading to the sewer is intended to be trapped by inverting the end connected with the cesspool. But it frequently happens that the cesspool leaks, and the mouth of the pipe is above the level of the water, consequently there is no barrier to the free inflow of sewer-gas, and its further progress into the house through the soil-pipe, likewise untrapped. The difficulty of ventilating a cesspool or privy-pit without the extravagant use of heat is insurmountable, and therefore efficient ventilation is rarely or ever secured. If the fixtures in the house are not securely trapped, and if the soil-pipe is neither trapped nor ventilated (defects which usually accompany this mode of drainage), the cesspool will be ventilated by the soil-pipe leading into the house.

### House Refuse.

In cities and towns, but especially in places where no sewers exist, or where they have been only recently constructed, the evil effects of the storage of excreta upon the premises can hardly be imagined, except by those who have made it an object of special investigation; and the contamination of air, water and soil, to which it gives rise, if it could be closely traced in its influences upon the human body, would be found to

be the means of spreading some of the most common and most fatal forms of disease.

House refuse, such as ashes and dust containing organic matter, kitchen garbage and the waste from the table, if not promptly removed, becomes highly offensive, and will cause a nuisance on the premises by its retention.

### Composition of the Air of Sewers and Cesspools.

The air of sewers, house-drains, cesspools, and privy-vaults is always more or less impure on account of the decomposition of excreta and other waste matters which these receptacles contain. It may also carry with it, under certain circumstances, the specific poisons which produce enteric fever, cholera, dysentery, and possibly other diseases of the so-called zymotic class. It is influenced in its composition, to some extent, by the degree of ventilation and the amount and character of the substances besides excrement present in the sewer or receptacle of filth; but, in general, it contains well known gases, and also fetid organic matters, the nature of which, however, has not been accurately determined. These gases are dangerous to health in proportion to their degree of concentration. If inhaled in large quantity and in concentrated form, they may prove quickly fatal. Not a few cases have been recorded in which men have breathed the air of unventilated old cesspools, or long-blocked sewers, with serious and sometimes fatal results. But in a diluted state, these gases manifest their effects upon the system by a condition of general *malaise*, and a depressed state of the health. The gaseous products of organic decomposition are less important than the organic matters of which sewer-air is partly composed, since these latter substances are supposed to be more specially concerned in the propagation of disease.

The air of cesspools and privy-vaults is not of uniform composition, but it generally contains, in variable quantities, sulphuretted hydrogen, ammonium sulphide, nitrogen, carbonic acid, carburetted hydrogen, and fetid organic matters. It may also contain those subtle organisms which are supposed to be the active agents in the production of some of the most fatal diseases.

The air of sewers is a varying mixture of the gases which compose the atmosphere, together with certain other gases produced by the decomposition of sewage-matter, which also vary in quantity. That organic matters are also present in the air is apparent from the fetid smell and from certain well known reactions derived from chemical tests. The gases are similar to those met with in the air of cesspools. As compared with atmospheric air, there is a less amount of oxygen and a greater quantity of carbonic acid in sewer-air. The other constituents are nitrogen, sulphuretted hydrogen, ammonium sulphide, and light carburetted hydrogen. All of these gases are not invariably present, but carbonic acid and nitrogen are the most common, while the other gases, when present, exist

in limited quantities. The character of the sewage, the rapidity of the flow, temperature, access of atmospheric air, all have important influence in determining the character of the air within sewers.

### **The Nature of Sewage and the Conditions in Which it is Most Dangerous.**

Sewage is a complex liquid formed principally of solid and liquid excreta, house-slops, fluid refuse from various branches of industry, and the washings and debris of the public thoroughfares. Certain ingredients of this heterogeneous mixture are always present in a greater or less quantity, and these give to sewer-air its more definite and characteristic properties. The air of a well-ventilated and self-cleansing sewer may be so diluted by atmospheric air as to make it impossible to detect, even by chemical analysis, any but the slightest variation from the normal condition of the atmosphere. Even in badly constructed and ill-ventilated sewers, the amount of variation from normal air is not very great. But as before remarked, it is not the gases of decomposition, "the so-called common chemical poison," that constitute the most dangerous constituents of sewer-air; it is rather the organic infective matters, "the morbidic ferments or contagia; matters which are not only not gaseous, but on the contrary, so far as we know them, seem to have their essence, or an inseparable part of it, in certain solid elements which the microscope discovers in them; in living organisms, namely, which in their largest sizes are but very minute microscopical objects, and at their least sizes are probably unseen even with the microscope; organisms which, in virtue of their vitality, are indefinitely self-multiplying within their respective spheres of operation, and which, therefore, as in contrast with common poisons, can develop indefinitely large ulterior effects from first doses which are indefinitely small."

Prof. Frankland has shown by experiments, that liquid and solid particles, the probable disease-producing matters, are not likely to be dispersed into the air from sewage-matter by the ordinary agitation of the sewage. This does not occur, as a rule, until after decomposition has taken place; the bursting of minute gas-bubbles on the surface of the liquid consequent upon the generation of gas within the body of the liquid, scattering the minute particles into the surrounding air. These minute solid particles are but slightly diffusible, but are capable of being transported by the air into houses having sewer-connections. The conclusion to be arrived at from this discovery is that the flow of fresh sewage through a well-constructed sewer, which permits of no retention of excrementitious matters and, therefore, of no putrefaction, is not likely to be attended by the suspension of morbidic matters in the air of the sewer. On the other hand, when there is stagnation of sewage and putrefaction of excrementitious matters, these minute and dangerous substances are extremely likely to be present in the air of a sewer.



### Methods of Removal of Excreta.

A great many different methods are employed for the removal of excreta, as might be expected, since no one system can be perfectly adapted to the varied wants and circumstances of all places. These methods may be divided into two classes: the *water-carriage system*, by which the waste matters are carried away in underground conduits by the use of water; and the *dry systems*, which consist in the admixture of dried earth, ashes, or other dried refuse with the excrement in sufficient quantities for absorbing and reducing it to an inodorous form, so as to prevent foul putrefaction, and the evils attending the process of decay. *Other plans* are in use, which provide for the removal of the excremental matters in a fresh state without the admixture of absorbents, such, for example, as the pail system; and there is also the very common plan of retaining these matters upon the premises, in cesspools and privy-vaults, a plan which is dangerous to health and, therefore, ought to be discontinued, especially in populous places.

### Advantages of the Water-Carriage System.

The system of removal of excreta and house-slops by water-carriage in underground conduits is undoubtedly the best for health and economy. It recommends itself on account of cleanliness, convenience, economy, and the rapid and complete manner in which the removal of the waste matters can be effected. When all the conditions necessary for the success of this plan are available, there never should be a doubt as to the choice of this system. Local circumstances will have great weight in determining the choice between this system and the dry system. In towns where proper sewers have not been constructed, or where the supply of water for flushing is deficient, or where the final disposal of the sewage-matter cannot be safely provided for, it will be most advantageous to adopt some form of dry removal.

In the application of the water-carriage system, advantage may be taken of the waste water for flushing purposes, so that but little additional expense need be incurred for the water required for the closets; and, moreover, since channels must necessarily be provided for the removal of surface waters and the water used for domestic purposes, it is evident that with but slight additional expense these channels can be so constructed as to be efficient conduits for the removal of excreta also.

### Conditions of Success in the Water-Carriage System.

The conditions to be observed in order to render the water-carriage system successful have been summed up by Mr. Simon, as follows:

“1. That the closets will universally receive an unfailing sufficiency of water properly supplied to them. 2. That the comparatively large

volume of sewage which the system produces can be in all respects satisfactorily disposed of. 3. That on all premises which the system brings into connection with the common sewers, the construction and keeping of the closets and other drainage-relations will be subject to skilled direction and control." And we may add, that the sewers will be properly constructed and well ventilated, and kept under efficient supervision and control. If all these provisions be combined and properly carried out, there can be no doubt of the success of the system.

### Faults in Sewers.

These principles are so frequently disregarded in practice, that it is not surprising that health has been endangered by the presence of sewers, and the system, in consequence, brought into disrepute. The fault is not with the system, but with its improper execution. When sewers are badly designed, and built of poor materials put together in an unskillful manner, they virtually become cesspools under the street, and have all the disadvantages of this common nuisance. Instead of acting as channels for the continuous and rapid passage of sewage-matter, they become sewers of deposit. The solid matters accumulate and obstruct the flow, while the liquid portions escape into the surrounding soil. The detention of organic matter in the bottom of a sewer gives rise to putrefactive changes and the generation of the gases of decomposition, and the suspension of zymotic matters in the air of the sewer. If, in addition to these defects, there is a want of ventilation, the conditions are very favorable for the transportation of poisonous vapors into houses, through untrapped and unventilated house-connections.

The early sewer-works were constructed in a very unskillful manner. It was taken for granted that the sewers must eventually choke up from the accumulation of deposit, and they were therefore made large, so that men could enter them for the purpose of removing obstructions. The principles upon which sewers are now made self-cleansing do not appear to have been well understood, at least they were never applied in practice. It has often been the case that conduits originally intended for surface-waters and house-waters, have been made use of for the removal of excreta, with scarcely any or no modification for this additional service. It is not surprising, that, under the circumstances, the results have been extremely unsatisfactory. But new works intended for the removal of excreta are often built in a similarly defective manner, without the least regard for the sanitary objects which a system of sewerage is primarily intended to secure.

### Sewers.

In inhabited areas, the provision of underground conduits for the removal of surface-water, and the waste matters from houses, sooner or

later becomes an urgent necessity. In small places, the open gutter is made use of for the disposal of house-slops as well as rain-water; but, as house-slops are in reality a condensed form of sewage, this practice cannot be defended on sanitary grounds. \*It is only a temporary expedient until proper channels for house-slops can be provided. When provision cannot be made upon the individual premises for the proper disposition of this waste material, the necessity exists for the construction of public sewers. Hence, in most towns, these public conveniences are sooner or later brought into use. Sewers are used for the purpose of removing surface-water and house-slops, and the liquid refuse of trades and manufactures, either with or without the admixture of human excreta. When the rain-fall is excessive, separate channels are sometimes provided for the rain-water, and this constitutes what is called the "separate" system. Sewage matter is a heterogeneous mixture, composed of human excreta; the water from kitchens, containing vegetable and animal matter; the water from wash-houses, containing soap and animal matter from soiled clothing; the refuse from trades and factories; the drainage from stables and slaughter-houses, containing animal and vegetable matter; and the washings and débris from streets and exposed places. It is, in fact, water polluted with a great variety of matters, both animal and vegetable, which are susceptible of putrefaction, and therefore should be disposed of as rapidly and completely as possible. Whether sewage should be permitted to pass into streams, or not, will depend on a variety of circumstances. It is certainly the simplest and most convenient way of disposing of it; but, upon general principles, it should be forbidden until after purification. When the sewage is of moderate amount, and the body of water is large, and has an active current, excessive dilution of the matter may prevent any injurious consequences.

Whether storm-waters should be permitted to pass into sewers, is a question which has excited discussion. Local conditions and circumstances must be consulted before determining this point. In small places it is not advisable to provide for the underground removal of all the water of heavy rains; but in cities and large towns all sewerage works must be designed to carry away, either by sewers or special channels, the greatest amount of rain-fall without any inconvenience to the inhabitants. The discharge of rain-water into sewers has the advantage of its scouring effect; but, on the other hand, when sewers are built sufficiently large to accommodate the water of heavy storms, they are too large to admit of self-cleansing by the ordinary daily flow. This objection may be overcome, in part, by adopting the oval form in the construction of sewers, which is the shape that will best meet both of these requirements.



### Conditions to be Observed in the Construction of Sewers.

The conditions necessary to observe in the construction of a sewer are summed up by Mr. Waring as follows:

"1. It must be perfectly tight from one end to the other, so that all matters entering it shall securely be carried to its outlet, not a particle of impurity leaking through into the soil.

"2. It must have a continuous fall from the head to the outlet, in order that its contents may keep moving, there being no halting to putrefy by the way, and no depositing of silt that would endanger the channel.

"3. It must be perfectly ventilated, so that the injurious gases that necessarily arise from the decomposition of matters carried along in the water, or adhering to the sides of the conduit, shall be diluted with fresh air, and shall have such means of escape as will prevent them from forcing their way into houses through the traps of house-drains.

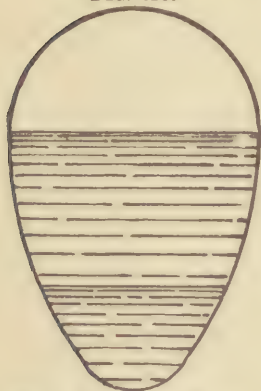
"4. It must be provided with means for inspection, and, when necessary, for flushing.

"5. Its size and form must be so adjusted to its work, or to its flushing appliances, that the usual dry-weather flow may be made to keep it free from silt and organic deposits."

In constructing a sewer of sufficient capacity to accommodate the storm-waters, we obtain a capacity excessive in proportion to the volume of sewage ordinarily flowing through it. The ordinary stream of sewage being small in proportion to the size of the sewer, and consequently being

spread over a large surface, the velocity of the current is so impeded by the bed and sides of the channel, that solid matters are deposited and accumulate until the sewer becomes completely blocked up. This difficulty is in part overcome by adopting the oval form, represented in Fig. 119, which is always to be preferred when the volume of sewage-matter is subject to fluctuations. When the volume of sewage is large, and maintains a uniform flow, the circular sewer is to be preferred.

FIG. 119.



MODERN SECTION OF SEWER.

Sewers intended to carry the waste matters of a population should be made water-tight. When of more than eighteen inches internal diameter, they are usually constructed of bricks set in cement or hydraulic lime mortar. The bricks should be hard, well burnt, and well shaped, and such as are used for the inner lining should have a smooth surface. Sewers of less than eighteen inches internal diameter are usually made of stoneware or earthenware pipes, and sometimes of iron. These pipes should be glazed, both inside and outside, and should be of uniform thickness,

of true section, and free from cracks or other imperfections. The form of pipe generally used is the simple socketed pipe, with spigot on one end and socket on the other. The greatest care is required in adjusting and securing the joints. The best cement should be used for jointing the pipes, and special care should be taken to see that none of the material is left to protrude inside the pipe. In laying the pipes, care should be taken to have a well-regulated fall, and each pipe should have a uniform bearing throughout the entire length of the sewer. To secure a true position and a firm support, the bottom of the trench should be hollowed out to receive each joint. A bed of concrete will give stability to the drain.

Iron pipes are used when sewage has to be carried across a river or from one side of a valley to another. They are preferred for private drains. It is essential, however, that they should be of sufficient thickness to be durable and to resist all strain. They should be free from all sand holes or other defects, and should be coated inside and outside, while at a high temperature, with coal-tar pitch. A careful testing should be required before use. The same principles apply to the construction of house-drains.

### Flushing of Sewers.

A well-constructed sewer is theoretically self-cleansing; but practically it will require periodical flushing to remove the slime and filth that adhere to the sides and bottom and undergo decomposition. The scouring effects of the storm-water, are generally depended on to accomplish this purpose; but this is an irregular and uncertain agency. In the dry season, when flushing is most needed, weeks may elapse without any sufficient amount of rain to accomplish this object. Arrangements for flushing are therefore absolutely necessary to remove deposits and keep the channels clean and free from obstructions. Flushing-tanks are used for this purpose, or, by a system of flush-gates or valves, the sewer-water may be held back for a time, and then allowed to escape, with an effect similar to that produced by a heavy fall of rain.

### Ventilation of Sewers.

Sewer-ventilation is even more important than sewer-flushing, though neither the one nor the other can be safely dispensed with in any system of sewerage. By the free admission of atmospheric air, pressure is relieved, the sewer-air is diluted, and the decomposition of organic matters contained in sewage is reduced to a minimum. One of the simplest ways of providing ventilation is by means of man-holes and lamp-holes in the centre of the street. The openings to these shafts are provided with gratings for the passage of air. The escaping vapors are often very offensive, and are complained of as a nuisance. Such complaints may

be taken as evidence that the sewer does not carry out its object; that the filth stagnates and collects as in a cesspool, and that a radical reconstruction is required. To close the openings in the street would be most injudicious; for, while it would diminish the nuisance in the public way, it would greatly add to the risk of people having connections with the sewer. The ventilation of sewers by rain-water pipes has been recommended and tried; but the method is not to be advised, as it may prove disastrous, as in the case of Croydon, where the system was abandoned after having been rigorously enforced for a number of years.

### House-Drainage.

No system of house-drainage can be said to be complete that does not insure the rapid and thorough removal of all liquid refuse, waste-water, and fecal matter, without leakage by the way, and, at the same time, prevent the entrance of air from the sewer or from the drain into the house. Generally speaking, these objects are very imperfectly attained, either on account of faulty construction of the drainage arrangements, or from defects in the plan of the works, or from subsequent mismanagement. A detailed account of all the varied appliances which have been suggested and made use of in connection with house-drainage, would be a laborious and unnecessary task, and entirely beyond the scope of these pages. It will suffice to point out the correct principles upon which a system of house-drainage should be based, and the means by which these principles are to be carried into effect, so that the evils attending a bad system of drainage may be avoided. The faults most commonly met with will also be pointed out.

The waste matters from water-closets, sinks, baths, and other fixtures, are received and conveyed into the sewer or other outlet by pipes made of iron, except in that part of the drain which lies between the house and the sewer, where the pipes may be of iron or earthenware. The vertical pipe which conveys these matters to the house-drain is called the *soil-pipe*. *Waste-pipes* are the smaller pipes, usually made of lead, which carry only the waste water of wash-stands, baths, sinks, and so forth, into the soil-pipe or common drain. The *house-drain* is the large pipe which receives the foul water from the soil and waste-pipes, and conveys it outside the house. That portion of the drain extending from the outside of the house to the public sewer, is sometimes called the *house-sewer*. The term is a convenient one in describing the various parts of the system of house-drainage.

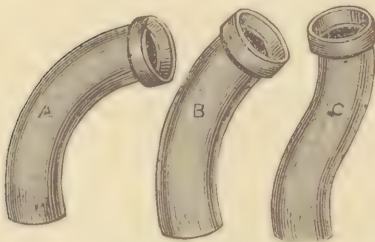
### Construction of House-Sewers.

The house-sewer, for a distance of eight or ten feet from the front wall of the house, may be made of iron or cylindrical, salt-glazed, earthenware pipes. If the ground is not firm, as in the case of "made ground," and there



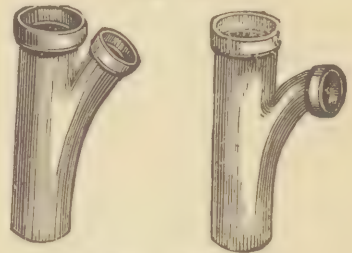
is danger of settling, or if a well or spring is not far distant, it is advisable to use iron pipes exclusively. On the other hand, if the soil is a natural bed of loam, sand, or rock, a well-laid and concrete-protected stoneware or earthenware drain will be sufficient for every purpose. In laying these pipes, care must be taken to make the joints thoroughly water-tight, so as to prevent the escape of liquid sewage and the collection of sediment which will, in time, obstruct the flow of sewage. A bed of well-puddled clay will form a good rest for the pipes. If the soil is loose, a broad bed of concrete will give a better support. The pipes should be jointed with the best cement, freshly made, each section being made wet before the cement is applied. Any cement which may be forced within the pipes in making the joints, should be carefully wiped away; otherwise, obstructions may be formed which will intercept the flow of sewage. To prevent this accident, it has been recommended that the joints be first packed with tarred gasket, and then filled with cement. If afterward they are bedded in cement or concrete, a thoroughly tight joint is obtained, which will be proof against the penetration of roots of trees and shrubs, which, if admitted, speedily choke the pipes and render them

FIG. 120.



A, QUARTER BEND. B, EIGHTH BEND. C, OFFSET.

FIG. 121.



CURVED JUNCTIONS.

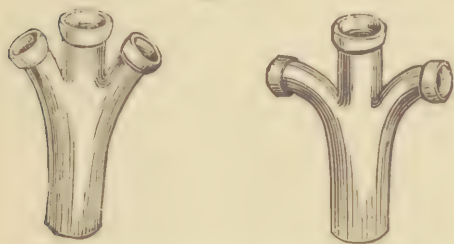
useless. Coating the joints with coal tar, or packing them with asphalt, is said to prevent this accident. Care should be taken to see that the different sections are in perfect line throughout, and that the proper amount of declination or fall has been secured.

In order to give additional security, it is sometimes the practice to set the entire line of pipes in a bed of concrete. When the drain is very long, means of access should be provided in order to detect and remove obstructions. For this purpose a lidded pipe may be used. The lid or cap is made sufficiently tight to prevent any escape of gas or liquid, and is capable of being removed without disturbing the drain. By inserting access-pipes at intervals of, say one to every ten sections, the whole drain is brought under control, and may be cleaned by means of jointed rods or flexible bamboo, without disturbing the bed of the drain. The course of the drain should be as straight as possible. When such a course cannot be obtained, and it is necessary to change the direction, curved pipes should be used, such as are sketched at Fig. 120.

### Methods of Joining One Drain with Another.

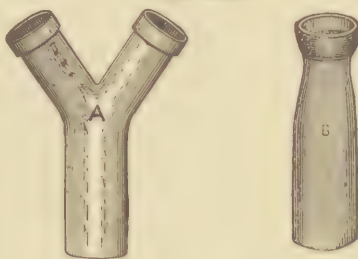
The union of one drain-pipe with another, or with the common sewer, should be effected by a curved junction, adjusted so as to deliver the sewage obliquely in the direction of the flow of the main current. Pipes are made with these junctions cast upon them. There are a great many shapes, but only those forms are represented by Figs. 121 to 123, inclusive, which are best suited to aid the flow of sewage from one pipe to another, without danger of causing deposits. These special pipes are made with single and double-curved, or oblique junctions, which are variously

Fig. 122.



DOUBLE-CURVED JUNCTIONS.

Fig. 123.



A, Y BRANCH. B, TAPER-PIPE.

inclined toward the line of the pipe, to suit the angle at which one drain-pipe may be joined to another. Square or right-angled junctions are also manufactured, but they should never be used, as they cause deposits which, in time, may block up the pipes.

It is often necessary to diminish the calibre of a pipe, and this can be properly done by using a diminishing, or taper-pipe, such as is shown at B, Fig. 123. Great damage may be done to a drain by inexperienced workmen, who make up the difference in section by using bricks, clay or cement, which, at best, can be only a temporary expedient. Wherever a bend or a junction occurs in the course of a drain, it is usual to give the pipe an extra dip.

### Sewer-Connections.

The house-sewer should be made to join the public sewer just within the water-line, and the junction should be made by the use of a "junction-block," or by a properly curved pipe built in the walls of the sewer. Junction-blocks are made of stoneware or fire-clay, and are built in the wall of the sewer when first constructed, or they may be inserted afterward, as occasion may require. The branch enters the sewer in an oblique direction, and forms an excellent way of making a tight connection with the sewer. Sewer-connections are ordinarily made in a very rude manner. The sewer may be so damaged by this careless practice as to ultimately lead to the caving in of its walls. The drain-pipe itself

often becomes dislodged, and its outlet obstructed. Rats burrow along the outside of the drain and open communication with the house, through which sewer-air gains admission.

### The Proper Size of Drain-Pipes.

The size of the drain-pipe is a matter of great importance. It should be large enough to carry away the greatest amount of sewage that is likely to be poured into it, and no more. Anything beyond that size is a positive disadvantage, as a scouring effect cannot be obtained when the flow of sewage is small in proportion to the size of the pipe. For an ordinary sized dwelling, a pipe four inches in diameter will be an ample size; for an extensive dwelling it may be necessary to use a pipe of six inches in diameter. In determining the size of the pipe, the amount of rain-water discharged into it must be taken into consideration.

### Construction of House-Draings.

Cast-iron pipes are the most suitable pipes for house-drains. In some cities no other kind of pipes is allowed to be used. The pipes should be sound, free from sand-holes and of uniform thickness. A pipe four inches in diameter, the size most commonly used, should be at least one-eighth of an inch in thickness. What are called extra heavy pipes are required in some special cases. The pipes, before use, should be tested for imperfections, and a coating of coal-tar pitch, both inside and outside, applied hot, should be made use of to prevent rust and to give smoothness of surface. The joints should be well leaded and well caulked, and the entire line of pipes should be firmly supported to prevent any strain upon the joints.

It is advisable to have the house-drain exposed to view above ground. It may be carried along the cellar wall or hung to the ceiling, care being taken to give it firm support. When it is not practicable to carry the line of pipes above ground, it should be placed in a trench upon a concrete bed of three or four inches in thickness, and walled up at the sides with brick laid in good cement. Movable covers should be provided to facilitate inspection.

The house-drain should be arranged in a straight line, if possible. If this cannot be done, any changes made in the direction should be made with easy bends (Fig. 120), and all connections with curved junctions (Fig. 121). The inclination or fall in the pipes should be such as to afford a free and uninterrupted flow of water to the outlet. The fall should be, as a rule, two and three-fourths or three inches to every ten feet, which is about one foot in forty.



### Some of the Results of Badly Constructed House-Drains.

Incompetent workmen fail to get the proper fall by neglect to use the spirit-level; or the drain may be purposely kept near the surface of the ground until it approaches the sewer, in order to avoid the expense of excavation. Whatever may be the reason for this unfortunate defect in construction, the results are the same. The drain becomes obstructed, the joints leak, the soil becomes sodden with filth, and the air of the house polluted. Under the circumstances, the health of the occupants of the house is sure to suffer. Mr. Teale has pictured the results of this shameful form of construction in a way that needs no comment (Fig. 124).

FIG. 124.



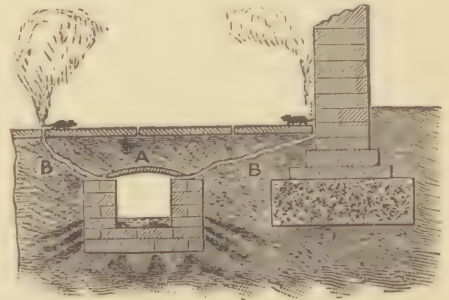
ECONOMY IN DIGGING AT THE EXPENSE OF FALL IN A DRAIN.

Where the house-drain passes through or under the foundation walls, it is a wise precaution to turn a relieving arch over it; otherwise the weight of the superstructure may cause the drain to crack or to open at the joints and leak, or the pipes may be crushed by the weight which they are not fitted to sustain. The leading of drain-pipes through the house is unavoidable in many cases; but when such is not the case, advantage should always be taken of the opportunity of keeping the pipes outside the house, though the plan may be inconvenient and more expensive. The necessity is more urgent when stoneware or terra-cotta pipes are used. Brick drains should never be used either inside or outside the house. It is impossible to make them either air-tight or water-tight, and in conse-

quence of these defects, foul liquids and foul gases escape and pollute the soil to a dangerous extent. Obstructions readily form, and, in time, such drains become converted into elongated cesspools. Rats work their way from such drains into houses, opening channels for the free admission of poisonous gases. Prof. Corfield says that such drains are still often found under old houses in England (Fig. 125).

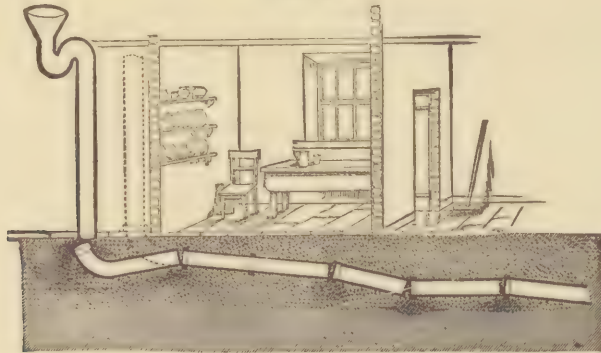
Vitrified stoneware or earthenware pipes should not be used for any part of the drain within the foundation walls. Until within a few years such pipes were employed for this purpose almost altogether, and they are still very commonly used. Experience has taught us that such house-drains are very insecure on account of their constant liability to get out of order. They are required to be placed underground, where faults are undiscovered until after serious consequences have ensued. Unless constructed with the most scrupulous care, the joints are apt to loosen, and the pipes to crack, from the settling of the earth about them, or from the pressure of walls upon them where they pass through the foundations. On account of the short lengths in which these pipes are made, the joints are numerous, and the chances of a joint becoming defective are thereby proportionally increased. In practice, it is almost impossible to make a firm connection between the upright soil pipe and

FIG. 125.



ESCAPE OF SEWAGE AND FOUL AIR FROM BRICK DRAIN UNDER BASEMENT.

FIG. 126.



EARTHENWARE HOUSE-DRAIN WITH GAPING JOINTS FROM SINKING OF THE GROUND.

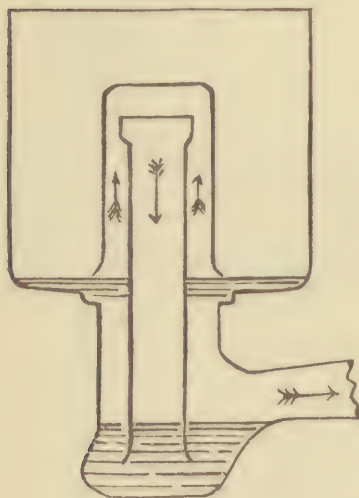
the earthenware drain, for notwithstanding the iron pipe may be well cemented into the socket of the latter, a settlement of the soil, or the weight of the vertical pipe, may cause the joint to open, and the sewage

to be poured out into the ground under the cellar. This very frequent occurrence is well portrayed by Mr. Pridgen Teale in the illustration shown at Fig. 126.

### Flushing of House-Drains.

It is very necessary that the house-drains should be occasionally flushed, so as to remove all obstructions and cleanse the surface of the pipes above the usual water-line, where offensive slime is apt to collect. It is of no value whatever to pull up the handle of the water-closet or leave the faucet

FIG. 127.



DOULTON'S FLUSHING TANK.

running; on the contrary, such a plan accomplishes no good purpose and wastes a large amount of water. What is required is a sudden discharge of a large volume of water, which will have the effect of washing the sides of the pipes, and carrying all deposits before it. To some extent this object is accomplished by providing a large cistern for flushing water-closets, so that with each use of the closet a considerable quantity of water is suddenly discharged into the soil and drain-pipes. Field's flush tank is used for the purpose of flushing drains in the country in connection with a system of irrigation. The scouring effect of the rain may accomplish all that is desired.

A very good plan is to collect the sink or bath-water in a tank, and let it discharge by the action of a syphon. The Messrs. Doulton, of Lambeth, have introduced a very simple flushing tank which collects the waste water from the sink, and when full discharges the contents into the drain by the action of a syphon (Fig. 127.)

### Importance of Preserving an Accurate Drain-Plan.

It is very important that a correct plan of the underground drainage arrangements of every house should be provided, showing the size and course of the pipes, the position of the bends, junctions, traps, access-pipes, and the depth of the pipes from the surface, and the nature of the soil.

### Ventilation and Trapping of Drains.

Two very important principles to be observed in every system of house-drainage are: first, the maintenance of a constant and ample supply of fresh air throughout the entire length of the main drain and the soil-pipe connected with it; and, second, the exclusion of sewer-air by means of



some kind of intercepting trap placed in the line of the house-sewer just outside the external walls of the building. The former object may be accomplished by carrying the soil-pipe, of full diameter, to some distance above the top of the house, and providing it with a cowl to improve the up-draught (though there is a doubt with regard to the utility of cowls or any covering whatever), the fresh air being admitted at the lowest part of the drain, just within the intercepting trap, that is, between the trap and the external wall of the house. In very cold climates, where an opening between the drain and the outer air might be dangerous on account of frost, the pipe admitting fresh air may be carried underground for some distance to temper the air before it enters the drain.

#### A Disconnecting Trap on the House-Sewer a Necessity.

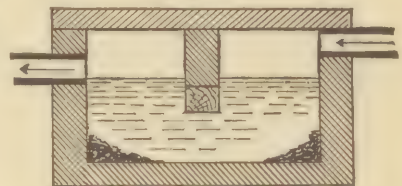
Some authorities recommend that the disconnecting trap on the main drain be omitted, as it tends to interrupt the free flow of sewage, and is unnecessary if the soil-pipe has a free opening above the top of the house. This advice is based upon the assumption that the sewers are well-constructed, copiously flushed, and freely supplied with air, conditions which seldom ever appertain to sewage works at the present day. It is true that such a plan will help to ventilate the sewers, but it is just as true that the omission of the disconnecting trap in the present condition of these works will bring every house into dangerous communication with the foul air in sewers, and within the influence of infectious matters discharged from houses in which communicable diseases exist. Unless the outlet is of an exceptional character, such as that afforded by a river, lake or the sea, the trap on the main drain should be made use of.

A disconnecting trap to be effective must have an efficient and constantly maintained water-seal; and it must be of such a form that the whole of its contents will be entirely changed whenever a good flow of water is discharged into it. Such a trap should also be readily accessible for the purpose of cleansing.

#### Various Forms of Disconnecting Traps.

Some of the traps first brought into use have been found to be very defective. Among these may be mentioned the metallic flap or valve placed over the mouth of the house-sewer at its junction with the main sewer. These valves are liable to derangement, and under the most favorable circumstances never form an air-tight seal. The cesspool trap (Fig. 128), a most objectionable form of trap, is frequently met with in country houses,

Fig. 128.



OLD FORM OF CESSPOOL TRAP.

but hardly ever used in new work, except on the wastes of the kitchen and butler's sinks, for the interception of grease. It is usually constructed in one piece of iron with a partition in the middle extending some inches below the water-line. The partition is intended to bar the passage of gas; but as such a trap accumulates foul matter, which is constantly in a state of putrefaction, the diaphragm is ineffectual in preventing the admission of foul gases to the house, except from the pipe leading to the main drain or sewer. This trap is sure to become a nuisance, and should never be tolerated in its unmodified form.

### Syphon Traps, Trapping of Main Drain, Etc.

Traps used for disconnecting the house-drain from the sewer are generally made in the syphon form. The oldest form is the running syphon, shown at A, Fig. 129, which is fatal to many objections. It was first made without any means of access for cleansing. This defect was discovered, and a central or cleansing opening was added at B. This also was found

to be a defect, as solid matters will rise and float on the water, and eventually obstruct the trap. This opening was also used for the entrance of perpendicular drains, a practice which often caused deposits to form. An improvement was made when the hand-hole for cleansing purposes was placed

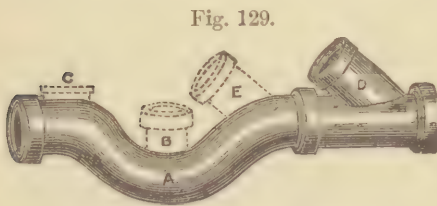


Fig. 129.  
RUNNING SYPHON-TRAP, WITH MODIFICATIONS.

where shown by the dotted line at C. This opening may be used as an inlet for fresh air as well as a means of access to the trap. Mr. Eassie recommends, when laying down a syphon, the use of a pipe next to it having a raking piece, D, for the introduction of the hand or cleansing rods. A raking piece is often cast upon the syphon itself, as shown by the dotted line E.

A simple form of syphon trap is represented at Fig. 130. An opening of the same diameter as the drain is cast in the trap on the side toward the house, which allows the free passage of air through the drain, and at the same time affords a means of getting at the interior of the trap. A chamber is walled up to the surface of the ground, and its top covered in with a perforated lid, or fitted with a grating. If desirable, the top may be sealed, and an air-duct taken from the side of the man-hole to some other convenient point.

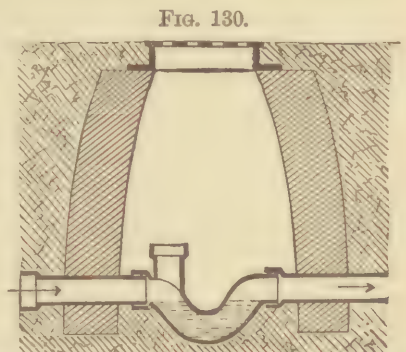


Fig. 130.  
SYPHON TRAP AND FRESH-AIR INLET LOCATED IN A MANHOLE.

In the ordinary syphon trap, the inlet and outlet are on the same level, and therefore the flow of sewage is apt to be sluggish, and deposits are liable to form. To overcome this objection, it is now the practice to have the inlet side of the trap, next to the house, a little higher than the level of the water in the trap, so that the sewage shall sweep through the trap with considerable force, carrying all suspended matters with it to the outfall. Buchan's trap (Fig. 130) is one of the earliest traps made upon this principle. It is provided with a hand-hole, and with an inlet for fresh air, A. From C, the mouth of the inlet-pipe, the sewage has a fall of three inches to the level of the water B, which assists very materially the self-cleansing property of the trap.

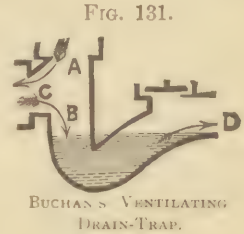
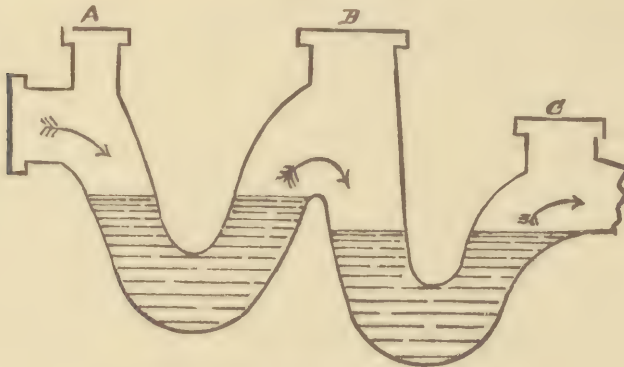


FIG. 131.

Traps with double water-seals are sometimes used when there is excessive pressure from the sewer. Such a trap is represented by Fig. 132. It will be observed that there is a considerable fall from the level of the water in the first trap to that of the second, or the one toward the sewer. This provision is made to counteract the tendency to obstruction from a double dip of the pipes; but notwithstanding this device, the traps become obstructed,

FIG. 132.



CANDY'S DOUBLE WATER-SEAL DRAIN-TRAP.

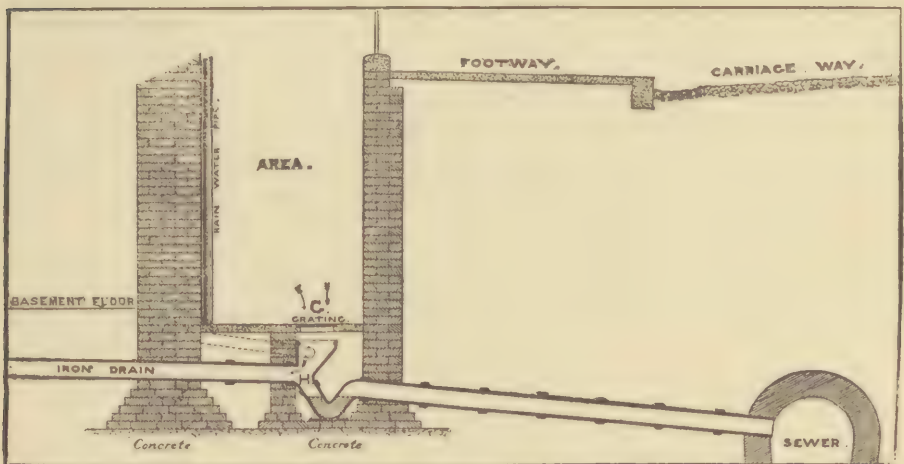
and therefore should only be used in very exceptional cases. A represents the inlet for fresh air; B the outlet for sewer-air, should it force the water in the first trap; and C the inspection-hole. The vent-pipe is attached at B and carried to the surface of the ground, some distance from the house.

Mr. Hellyer has invented a drain-trap which he calls the ventilating drain-syphon and sewer-interceptor. This trap, shown at II in Fig. 133, "consists of a round pipe shaped in the form of the letter V, giving it a dip or water-seal of about three inches, and the body of the trap is com-



paratively of smaller diameter, to prevent any filth collecting in the trap, and also to allow the water in the trap to be more easily driven out by flushes from the drain." There is a fall of six inches from the drain to the level of the water in the trap, which affords a force sufficient to drive the water out of the trap with a scouring effect. The upper part of the trap is enlarged and carried upward for the admission of fresh air through a grating, G. When this part of the trap is not high enough to reach the surface, it may be built up with brick-work, the grating removed from the trap, and a grating placed over the outlet at the surface of the ground.

FIG. 133.



SECTIONAL VIEW OF HOUSE-DRAIN, HOUSE-SEWER, WITH HELLYER'S VENTILATING DRAIN-SYPHON IN POSITION.

This trap may be placed in a man-hole, as shown in Fig. 130. When there is an open area, the trap and drain may be arranged in the manner suggested by Mr. Hellyer, and represented in Fig. 133. This figure also shows the proper way of leading a rain-water leader into the main or intercepting trap. When there is fear of gases passing from the sewer through the trap, and into the house through the basement windows, the opening may be sealed, and a four-inch pipe carried from the air-chamber of the trap to a distant corner of the area, and a mica-valve fixed to the mouth of the inlet-pipe; or the air-duct may be carried under the footway to a convenient point at the surface of the ground.

#### Soil-Pipe Disconnection not Advisable.

The practice of fixing a trap at the base of the soil-pipe has of late become quite common in England; but in this country it has thus far had little or no application. A trap, such as is represented by Fig. 134, is placed at the bottom of the soil-pipe, and all connection with the house-drain is severed by means of a water-seal. Air is admitted to the soil-

pipe from the air-chamber built in the trap. A man-hole is also provided for cleansing the trap and drain. The force of the water in falling down the soil-pipe assists in keeping the trap free from all deposits; but by this system the house-drain is left without disconnection, which is a very serious disadvantage. It should be remarked that the difference between the English system and that adopted in this country depends on differences of climate. It is customary in England to carry the soil-pipes out-of-doors, and to restrict their use to the water-closet waste, the waste-pipes from baths, wash-stands, sinks, and so forth, not being connected with the soil-pipe, as in this country, but discharging over trapped gulleys in the open air. Our colder climate forbids such a practice, nor is it necessary when the soil-pipe is properly constructed and ventilated, and all the fixtures are well trapped.

FIG. 134.

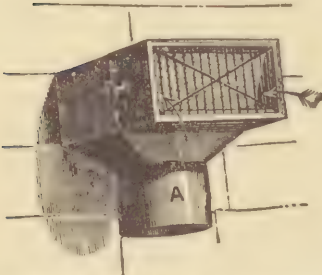


HELLYER'S TRAP AND SOIL-PIPE DISCONNECTOR.

### Fresh-Air Inlets and Mica-Valves.

The inlet for fresh air should be of the same diameter as the iron drain, and the pipe leading to it should be carried to a point remote from any window. Some of the plans for arranging such inlets have already been mentioned.

FIG. 135.



HELLYER'S MICA-VALVE FOR VERTICAL AIR-PIPE.

If the inlet-pipe must be near the house, it may possibly cause a nuisance by the occasional escape of foul air. To avoid this objectionable feature, a mica-valve may be fixed over the mouth of the inlet-pipe. Such valves are adapted to either horizontal or vertical inlet-pipes. A mica-valve for use with a vertical pipe is represented at Fig. 135. The mica-flaps are so light and so delicately adjusted, that the entrance of air is not obstructed; but when any discharge is sent into the soil-pipe, or when the air is driven down the soil-pipe from any other cause whatever, the mica-flap closes and prevents its escape.

The main trap is sometimes placed within the cellar wall. It is a better plan to locate it outside the foundation walls, at a distance of at least three feet. For access to the trap, a man-hole should be constructed of brick-work in cement, and provided with an iron cover which should be perfectly air-tight. This cover should be kept locked to prevent any tampering with the drain. A current of fresh air is admitted to the man-hole by a pipe, at least four inches in diameter, opening at a safe distance

from the house. When the man-hole is not in too close proximity to the house, a grating may be placed in the cover for admission of fresh air, as shown in Fig. 130. When the trap is near the surface, an access-pipe, built around with brick and cement, may be carried to the surface and provided with an inlet-grating or close-fitting cover, as the case may be, and the man-hole dispensed with.

The inlet-pipes for fresh air should be arranged in such manner and position as will be most likely to prevent any accidental obstruction of the mouths of the pipes.

### Prevention of Back-Flow, Etc.

When a back-flow from the sewer is likely to occur, some means of preventing an inflow of sewage and the possible flooding of the basement of the house should be provided. Valve-traps are constructed for this purpose, their action being to close the mouth of the drain in the trap whenever any pressure from the sewer occurs. The greater the pressure, the more securely sealed will the trap become.

On completion of the house-drain, it is advisable to test it to see whether the joints are all sound. This may be done by blocking up the lower end of the drain, outside the walls, and filling the pipes with water.

### Cellar-Drains.

It is sometimes necessary to provide drainage for the cellar or the basement floor. When this must be done, the greatest care should be taken in selecting a proper trap, preferably one that has a deep water-seal, that will not be readily lost by evaporation. The trap should be

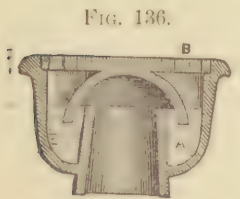


FIG. 136.  
BELL-TRAP.  
A, TRAPPING WATER; B, BELL-SHAPED COVER.

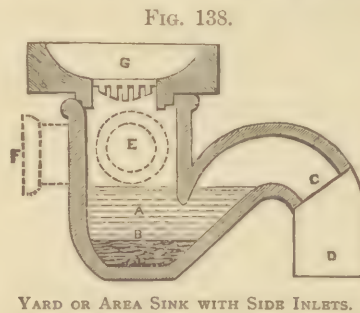
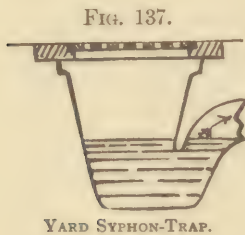
provided with a grating, and should be of a form that cannot be untrapped by lifting off the cover. The bell-trap, shown at Fig. 136, is sometimes used for cellar-floors as well as for a yard-trap; but it is a bad form of trap for any purpose. The little water it holds in the annular space, A, becomes displaced by the accumulation of dirt, or is lost by evaporation. The cup-bottomed grating, B, has a very slight dip in the trapping-water, and therefore affords but little protection. The bell-shaped cover is made to lift off for the purpose of cleaning out the trap, which is often required. The cup is apt to be broken, and the cover left off, in either case leaving no protection against the escape of foul gases. The easy accessibility to the drain is often taken advantage of by servants in disposing of various solid materials which properly belong in the ash-barrel. The S-trap has too shallow a water-seal for use in the cellar-drain.



### Yard and Area Sinks.

For yard and area sinks the common bell-trap, above described, should be discarded, and a simple syphon form of gulley, somewhat deepened, used in its place. A plain form of syphon-trap is shown at Fig. 137. The trapping-water has considerable depth, and therefore is not easily evaporated. A further advantage of this form of sink is the retention of the water-seal when the grating has been removed for the purpose of cleaning out the silt. If the climate is not too severe, and there is no danger of the trap becoming inoperative by obstructions of ice, it is a good plan to carry the rain-water leader into a side opening over the trapping-water. The waste water from the kitchen sink may also be lead into such a trap above the trapping-water, and in this way the sink may be disconnected from the main drain. The high temperature of the water from the kitchen sink will keep the trap free in cold weather.

Mr. Eassie recommends a form of sink for use in the yard or area, which has cast upon it side-inlets for disconnecting the wastes of sinks or lavatories or rain-water pipes. In this form, shown at Fig. 138, F and



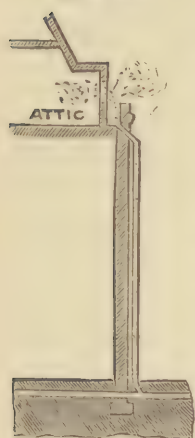
E represent the side entries; G, the cupped cover with grating; A, the trapping-water; B, the space for the accommodation of deposits, and C, the outlet. When used for the waste of the kitchen sink, a trap should be inserted close to the fixture, otherwise cold air will rush through the pipe into the room. Another precaution is to have the pipe leading from the kitchen sink ventilated to prevent the accumulation of foul air in the pipe, and its possible discharge into the room. When these traps are used within doors, as in an enclosed area, or in the cellar floor, it is necessary that the discharge-pipes should be well ventilated.

### Grease-Collecting Chambers.

Large houses require the provision of grease-traps in connection with the kitchen sink to collect the grease, and prevent it from congealing in the drain and blocking it up. This is especially necessary when the kitchen sink is situated at a point remote from the outfall of the drain into the sewer. When grease once collects within the drain it is impos-

sible to dislodge it by any amount of hot water or of chemicals, and in time the drain will have to be torn up to remove the obstructions. The grease chamber should be located out-of-doors; and to prevent it from becoming a nuisance, nothing but the waste from the kitchen sink should

FIG. 139.



RAIN-WATER PIPE CONNECTED WITH DRAIN AND OPENING UNDER THE ATTIC WINDOW.

be allowed to enter it. It should be covered and well ventilated, and its periodic cleansing properly attended to. Grease interceptors must be large, in order to contain sufficient cold water to at once cool the hot grease-laden water from the sink. For this reason they are apt to retain offensive matter and become very objectionable, unless cleansed at frequent intervals. The cesspool trap, or Mason's trap as it is sometimes called, already described on a previous page, is very commonly used as a grease-trap. As ordinarily made it partakes of the nature of the objectionable cesspool. It may be greatly improved by gently sloping the side nearest the outlet, and also by giving the dip-stone, or partition, a slanting direction corresponding with the flow of water, and by rounding off the angles so that no accumulations will take place. Whenever grease-intercepting chambers can be dispensed with, they should never be used. Ordinary dwellings do not require them, and larger houses might dispense with

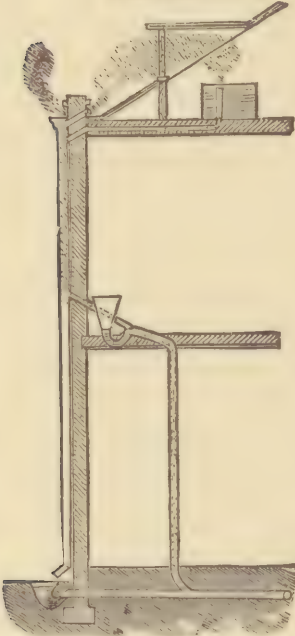
them if the unnecessary discharge of surplus fat into the drain could be prevented. For very large houses, restaurants, and so forth, the provision of grease-intercepting tanks becomes indispensable.

### Rain-Water Leaders.

Before dismissing the subject of the outside drainage arrangements of a house, we must refer to the proper arrangement of the rain-water leaders. It is often desirable to dispose of the rain-water from the roof-surface and from the yard by carrying it through the drain. This plan is not only a convenience, but it may be advantageous in another way by utilizing the flushing power of the storm-water in scouring out the drain. The plan of making the connection between the rain-leaders and the drain requires the exercise of great precaution, as a careless arrangement of these conductors may prove disastrous to the inmates of the house by the discharge of sewer-air close to open windows. A common practice is to carry the rain-leader direct to the drain at the most convenient point, and without any trap. These pipes frequently start close to windows, and in their descent receive branch pipes from balconies, bay-windows, and even bedroom wash-stands (Fig. 139). The foul air from the drain passes through these channels to open windows, and is liable to be blown into the house. When the house-pipes are not ventilated, the consequences may prove

serious. No rain-water leader should be permitted to enter a drain that is not freely ventilated, without first passing the water through a deep intercepting trap that cannot freeze. Even with this precaution foul air may accumulate in the conductor, and therefore it is advisable to insert in the conductor, near its foot, a small vent-pipe with its end turned upward, so as not to divert the flow of water. A trap is not necessary if the drain is perfectly ventilated, except when the leader opens near a garret window. In disposing of the rain-water discharged in front of the house, a good plan is to lead the end of the conductor into the inter-

FIG. 140.



RAIN-WATER LEADER DISCONNECTED AT FOOT,  
BUT VENTILATING SOIL-PIPE, ETC.

FIG. 141.



FAULTY ARRANGEMENT OF SOIL-PIPE AND  
RAIN-WATER LEADER.

cepting trap on the house-sewer just over the trapping-water, not on the sewer side of the trap, as by this arrangement the main sewer will be ventilated by the rain-water leader. Traps are constructed with side inlets for this very purpose. The rain-water collected in the rear of the house may be discharged over a trapped gulley, unless the climate is too severe to permit of this arrangement without the annoyance caused by freezing. In such cases a deep trap should be used, as it is not liable to freeze, and the leader or leaders made to discharge just above the trapping-water.



### Improper Position and Uses of Rain-Leaders.

Rain-conductors should be kept outside the house, especially when such conductors have connection with the drain. If used within the house, they should be of cast-iron with well leaded joints. They should never be used for ventilating any part of the soil-pipe and its connections. Fig. 140 shows how such a misuse of a rain-water leader may be the means of carrying foul gases into an open window and into a water-cistern (Corfield). Rain-water leaders should never be used as soil, waste or vent pipes, nor should any soil, waste or vent pipe be used as a rain-water leader. For the sake of economy, the soil-pipe is sometimes carried to the eaves of the house for the double purpose of carrying off the rain-water and ventilating the drain. The foul air constantly discharged from the mouth of a pipe in this position is liable to be blown into neighboring windows, and create a dangerous nuisance. This reprehensible practice is illustrated by a sketch by Prof. Corfield, which is shown in Fig. 141.

### Urinals.

Urinals have no proper place within a private dwelling. They are most difficult to keep clean, and even with the most assiduous care, are apt to give forth offensive smells. If they must be used their proper

place is out of doors, and even here they are liable to give trouble, not only by the disagreeable odor that hangs about them, but by freezing in winter and becoming, for the time being, useless. Mr. Hellyer recommends the form of urinal represented at Fig. 142 as a most suitable one for private places. The back and sides are of marble. The basin, A, is cupped to hold water and is copiously supplied with water from a pipe marked B. The urinal basin is supplied by treadle action. When the feet are placed on the platform-grating D, the supply-valve is opened, and the water continues to flow into the basin until the feet are removed. Beneath the grating a branch supply-pipe flushes a porcelain enamelled cast-iron safe, placed there to catch any drippings. The water should be supplied from a separate cistern. A

FIG. 142.



URINAL FOR PRIVATE PLACES.

frequent washing of the entire apparatus is required to keep it free from offensive smells. The outlet-pipe should be properly trapped and ventilated.

### Soil-Pipes, Their Construction, Etc.

The soil-pipe is that which conveys the contents of the water-closet, bath, wash-stands, and other fixtures, to the house-drain. It should be carried of full diameter above the top of the house for several feet, or a sufficient distance to be far away from any window or ventilating-shaft, or chimney that may act as a ventilating-shaft for a living room. Cows or return-bends are sometimes placed over the top of the soil-pipe, but it is best to leave the mouth of the pipe uncovered. The inlet for fresh air, placed just within the main trap in front of the house, will allow a current of air to sweep freely through the entire length of the house-drain and soil-pipe, and keep it properly ventilated. The soil-pipe should be of iron with joints well caulked with oakum and lead, and its union with the house-drain should be made by a bend of easy curvature. Where the vertical pipes join the house-drain, support should be given by building a brick pier about the point of union, so that the weight of the upright stack shall rest on a solid foundation. For ordinary dwellings the soil-pipe should not be more than four inches in diameter. Pipes of this diameter should be at least one-eighth of an inch in thickness, free from sand-holes or other imperfections, and coated inside and outside with coal-tar pitch applied to the pipes in a heated state.

Soil-pipes should have a vertical direction, and if this cannot be secured their course should be as direct as possible. It is an advantage to have these pipes, and, in fact, all the waste pipes and traps, exposed to view, so that they can be readily examined and conveniently repaired. When placed in recesses in the wall or within partitions, they should be covered with woodwork, arranged in such a manner that it may be easily removed without tearing the covering to pieces.

In building a house it would be wise to arrange for the construction of a special shaft, adjacent to the water-closet, for the soil and other vertical pipes. This shaft should be carried from the cellar up through the roof, and its top should be covered in such a manner as to keep out the rain while it admits light and allows of the free circulation of air in the shaft. Such a shaft should be two or three feet in diameter, and should be provided with a strong iron grating at each floor to stand upon while examining the pipes.

The English practice of running the soil-pipe on the outside of the house, and of having the waste-pipes discharge in the open air over trapped gulleys, is excellent in principle, but cannot be applied in this country, at least in a large part of it, on account of the greater severity of climate.

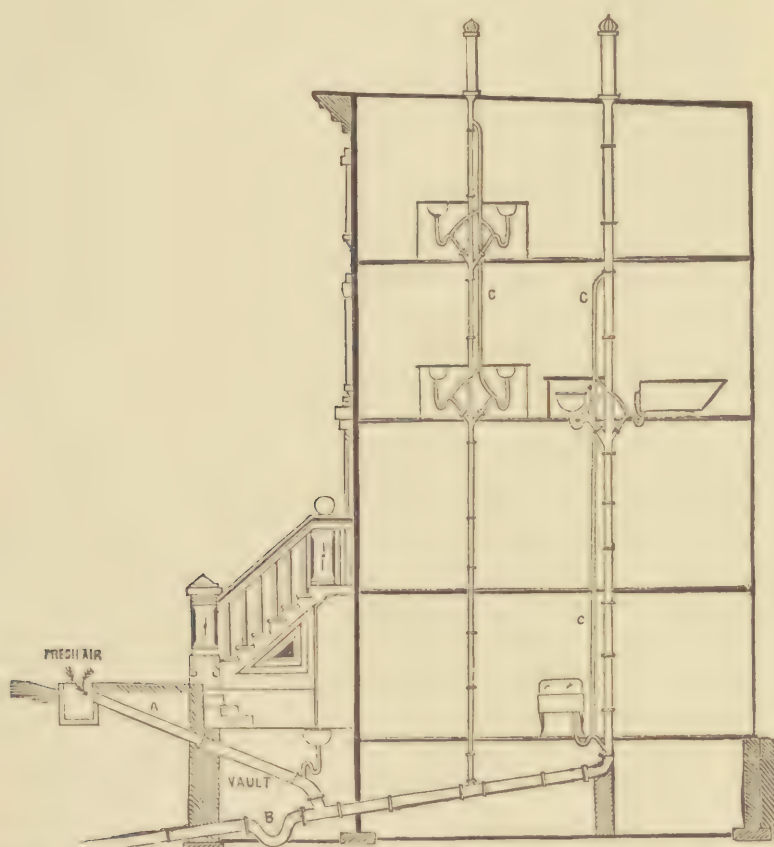
In fixing a soil-pipe it is very necessary to see that it is well secured to the wall of the building, to prevent any strain or displacement of the joints. In new buildings especially, it is necessary to take into considera-

tion the probable settlement of the walls, and give proper support to the pipes, so that no undue strain shall be exerted, which might cause a leak.

### \* Waste and Vent-Pipes.

The waste-pipes and vent-pipes inside the building, except the branch waste-pipes from fixtures, are made of cast-iron, and should be arranged in the same careful manner advised in the case of soil-pipes. They should be easily accessible for inspection and repairs. Vertical waste-pipes may

FIG. 143.



ARRANGEMENT OF THE SOIL, WASTE, AND AIR-PIPES, EXEMPLIFYING THE PRINCIPAL FEATURES IN A MODERN SYSTEM OF HOUSE-DRAINAGE.

be carried in the same shaft with the soil-pipe, unless the latter is located at an inconvenient distance, and they should extend of undiminished size above the highest part of the roof. Vertical waste-pipes are usually two inches in diameter.

In every system of house drainage it is important to protect the traps—with which every fixture should be provided—from siphonage, and to



ventilate the waste-pipes leading from them by means of a special air-pipe, of not less than two inches in diameter for water-closet traps and one inch and a half for other traps. The vertical vent-pipe should be carried above the highest part of the roof for at least two feet, and the extension, as in the case of waste-pipes, should be not less than three or more than four inches in diameter, to prevent obstruction from frost. In large houses, where the vent-pipe is used for a number of water-closets and other fixtures, it should be at least three inches in diameter, the branches from it to the water-closets being two inches in diameter, and those for the other fixtures being at least equal to the diameter of the trap. The mouths of all pipes carried above the roof should be left wide open, but protected with a spherical wire basket, and they should be at least twenty feet from any window, or from a shaft or chimney-flue used for ventilating rooms. When the air-pipe is not extended above the roof,—and it is not absolutely necessary in all cases,—it should be branched into the soil-pipe above the inlet from the highest fixture. The sketch shown at Fig. 143 will give a general idea of proper arrangement of the soil, waste, and air-pipes, also of the house-drain with main trap, and the inlet for fresh air. A is the pipe which admits fresh air to the drain, B the main or intercepting trap, and C the ventilating or air-pipe.

#### Testing of the Soil and Drain-Pipes When in Position.

When the soil and drain-pipes have been completed, they should be tested for the soundness of the joints. The water pressure test is made by plugging the drain at one end, and also the side openings, and filling it with water. This is a severe test, but the pipes should be sufficiently well constructed to stand it. The efficiency of the pipes, especially the upright soil-pipe, and the ventilating arrangements can be tested by burning some material in the mouth of the fresh-air duct, such as sulphur paper, which will produce considerable pungent smoke, and make manifest any defects in the system by the escape of smoke and the pungent odor. An excellent test is made by pouring oil of peppermint down the soil-pipe from the opening above the roof.

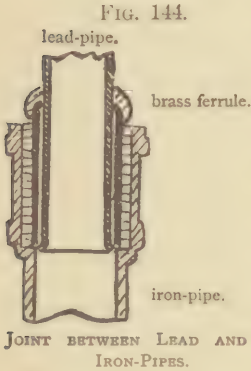
#### Joints Between Waste-Pipes and the Soil and Vent-Pipes.

The branch waste-pipes connecting fixtures with the soil-pipe are made of lead. This material has many advantages, among which may be mentioned the ease with which it can be bent, the small number of joints required, the smoothness of surface, and little liability to corrosion. The joints in lead-pipes should always be "wiped joints." When joints are made between lead and iron pipes, brass ferrules, or sleeves, must be used. The practice of using putty, lead or cement is most reprehensible. The connection between a lead-pipe and an iron-pipe is made as follows: A

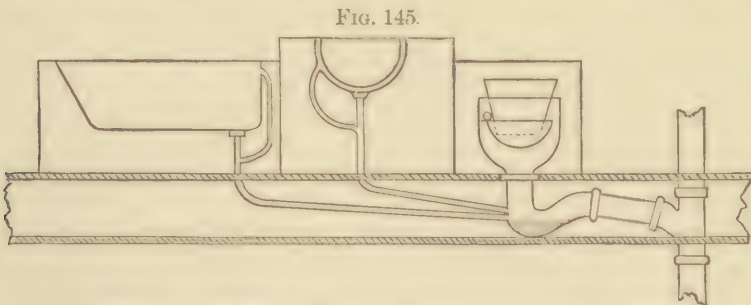
brass caulking ferrule is soldered to the end of the lead-pipe by a wiped joint, and this is inserted into the hub of the iron-pipe and the joint caulked with oakum and lead in the usual way, the brass giving the necessary rigidity (Fig. 144). Where the climate will permit it, waste-pipes may be made to discharge in the open air over trapped gulleys, a plan advised by English authorities. But this plan is not deemed essential by American authorities, as a waste-pipe well jointed with a soil-pipe, and well trapped and well ventilated, is believed to afford ample protection.

### Traps and Outlets of Fixtures and Branch Waste-Pipes.

Every fixture connected with a soil or waste-pipe should be provided with an effective trap, placed as near the fixture as practicable; and whenever possible each fixture should discharge into the soil or waste-pipe independently. It is not permissible for the waste of a bath-tub or other fixture to connect with the water-closet trap. This practice is a very common one, but should not be allowed for several reasons. The warm water from the bath and wash-stands mixing with the water in the water-closet trap, which frequently contains fecal matter, will give rise to offensive vapors, which, in their heated condition, are likely to escape through some opening into the room. The trap is never so perfect in its action after its surface has been broken by an inlet-pipe. Another risk may arise from the possible untrapping of the pipes by a slight tipping of the water-closet trap, or by a partial loss of the water-seal, as shown in Fig. 145.



The branch wastes should be as short and as direct as possible, and should have a proper fall. It is usual to carry the branch wastes from wash-stands a long distance under the floor, and terminate them in the



IMPROPER ARRANGEMENT OF WASTE-PIPES FROM BATH AND WASH-BASIN.

water-closet trap beneath the trapping-water, instead of into the soil or main waste-pipe. Not only is the outlet an improper one, but the want

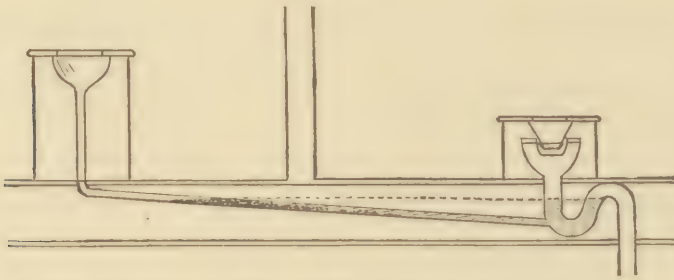
of proper fall in the long length of pipe is equally objectionable. The water stands back in the waste-pipe, as shown in Fig. 146, causing deposits and unpleasant odors. All outlet-pipes connected with fixtures, except water-closets, should be provided with strong metallic strainers.

### Drip-Pipes and Safes.

Whenever overflow-pipes are used for fixtures, they should be connected with the waste-pipe on the inlet side of the trap or below the level of the trapping-water, or they may in some cases discharge over a safe.

In order to protect the floor and the ceiling beneath it in case of leakage, safes of sheet metal, generally of lead, with upturned edges are usually placed under wash-basins, sinks, water-closets, and other fixtures. Safes

FIG. 146.



IMPROPER CONNECTION OF WASTE OF WASH-BOWL WITH WATER-CLOSET TRAP.

should be drained by special pipes made to discharge over an open sink in the basement or outside the house. They should never be permitted to have any connection whatever with soil or waste pipes. The careless arrangement of these drip-pipes is often the means of ventilating the soil-pipe into the house. An illustration of a dangerous arrangement of an untrapped drip-pipe of the safe of a water-closet is shown in Fig. 147. A trap affords no protection, as the water in it soon becomes evaporated and allows the foul air of the soil-pipe to flow freely into the room.

### Water-Closets.

Water-closets are made of enamelled iron, glazed earthenware, and china. Iron, when porcelain-lined, forms an excellent closet so long as the lining remains intact; but should it get chipped off or cracked, the water is brought into contact with the iron, oxidation takes place, and sooner or later the destruction of the apparatus follows. Glazed earthenware is more durable, and, in many respects, is to be preferred as the material for the construction of water-closets.

The great variety of water-closets offered to the public makes the selection of a proper apparatus an extremely difficult matter, and yet there is no question in connection with a system of house-drainage that calls for



more intelligent consideration. However complete may be the system in other respects, if the water-closet is of bad design it will be the cause of a most offensive nuisance in the house. It is not intended to describe the

FIG. 147.



SOIL-PIPE VENTILATED BY UNTRAPPED DRIP-PIPE  
OF SAFE UNDER WATER-CLOSET.

various forms of water-closets now on sale; it will suffice to allude to those forms only which differ essentially in their general features and plan of construction. These may be described as the pan-closet, the valve-closet, and the plunger-closet, or closets with movable parts; and the hopper-closet and washout-closet, or closets without any movable machinery.

#### The Pan-Closet and Its Defects.

The closet which is most open to objection, and which is more commonly met with than any other form, is the pan-closet (Fig. 148). It is a cumbrous appliance, defective in principle, unsatisfactory in operation, and incapable of such modification or improvement as will wholly correct its inherent defects. This apparatus, which is indicated in the annexed diagram, Fig. 149, consists of an earthenware basin, an iron container, and a lead D trap. The container, or receiver, is an iron box in the top of which

the basin itself is fixed. It contains a metal pan which is hinged and connected with a handle in such a manner that when the latter is lifted up the pan holding the water to form a trap falls in a vertical position, and its contents are thrown against the sides of the receiver, which soon become coated with a mass of foul matter. Beneath the container, and connected with it by a short pipe, is placed a trap, usually of the D pattern, which in turn is connected with the iron soil-pipe. The flushing-water is usually admitted at the flushing-rim from a branch taken from the service-pipe instead of from a separate-supply cistern. Whenever the handle is raised, a valve is opened and the water continues to flow only so long as it is kept in this position. Between the metal pan and the water in the trap is an unventilated space. Filth collecting in this space and on the sides of the container constantly gives off offensive gases, which are drawn into the apartment each time the closet is used. Even when the closet is not in use, foul air is admitted to the room through a hole in the container for the spindle to work in.

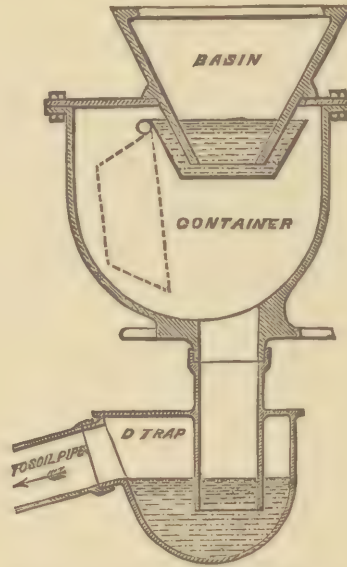
One of the most objectionable features about this closet is the D trap, which is almost always found in old closets. The interior of this trap becomes coated with filthy slime and obstructed with deposits from the

FIG. 148.



PAN-CLOSET.

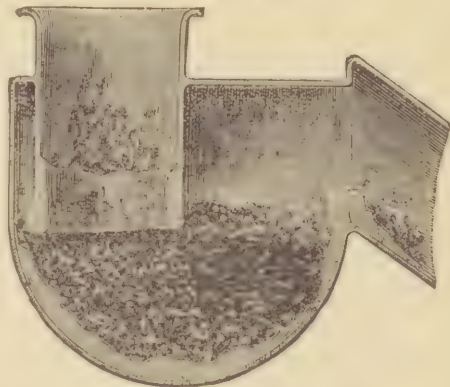
FIG. 149.



SECTION OF PAN-CLOSET WITH D TRAP.

lengthy detention of fecal matters, and emits a very unwholesome smell when the handle is pulled up. The accompanying illustration (Fig. 150) shows the condition of the interior of a D trap which had been in use for a long time. The safe required under a pan-closet to preserve the floor, has a drip-pipe leading into the trap below the water line. This arrangement allows the filthy water in the trap to stand back in the pipe, and from its surface a constant evaporation will take place into the room.

FIG. 150.



SECTION OF AN OLD D TRAP.

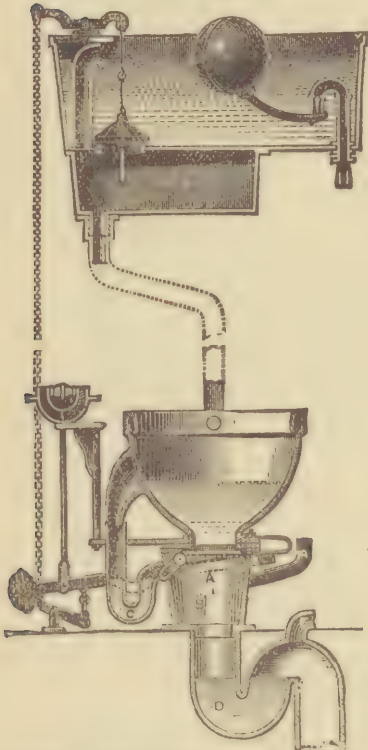
Improvements have been made in this closet. One of these is the thorough flushing of the basin from a supply-cistern. Another is the ventilation of the receiver and outlet-pipe. The provision of an S trap and also of an annular ventilating tube placed at the rim of the basin and connected with a pipe leading up the kitchen flue, and the use of a disinfecting apparatus discharging automatically an even

quantity of fluid into the basin at each closing of the pan, are improvements of some value. These improvements are merely palliative, and do not strike at the root of the evils inseparable from this form of closet.

### The Valve-Closet.

The valve-closet has very decided advantages over the closet just mentioned. The Hellyer closet, Fig. 151, may be taken as an excellent repre-

FIG. 151.



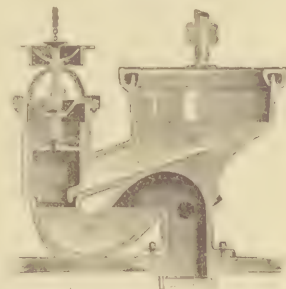
HELLYER VALVE-CLOSET WITH WASTE-PRE-VENTING CISTERN.

sentative of this variety of closet. It consists of a deep, glazed, earthen basin, charged about two-thirds full of water by means of a valve, which is a porcelain disk seated in a brass base having an India-rubber flange at its margin fitting tightly against a ground seat. The valve is hinged, and by raising the handle is turned from a horizontal to vertical position. It works in a porcelain-lined valve box, B, which is fixed over a lead trap, D, provided with a ventilating pipe, E. A trapped overflow-pipe, C, regulates the level of the water in the basin. To prevent the accumulation of noxious gases in the valve-box, and also to aid the escape of water through the overflow-trap and the closet-trap, an air-pipe, A, is taken from the side of the valve-box, and conducted out of doors. The flushing of the basin and all the parts of the apparatus is efficiently per-

formed by a flow of water through a one and a quarter inch pipe leading from a cistern and service box, which may be started by means of a lever and chain connected with the handle of the closet.

The valve-closet, if made of good materials and well constructed and set up, does not favor the retention of foul matter, and will be found very satisfactory in proper hands. The valve sometimes gives trouble by allowing the water to leak out of the basin, and the valve itself may become offensive if not occasionally cleaned; but these faults, if they may be called such, are very easily remedied.

FIG. 152.



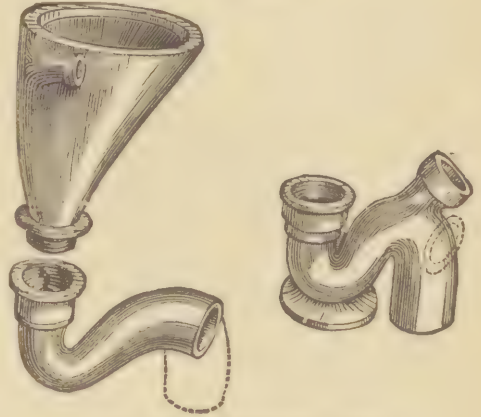
SECTIONAL VIEW OF PLUNGER WATER-CLOSET (THE HYGEIA).



### The Plunger-Closet.

A somewhat similar closet is the plunger-closet, in which the plunger takes the place of the valve. The water is retained in the bowl by a plug or plunger, which is lifted up by a handle when the closet is discharged. The plunger is contained in an upright cylinder connected with the basin on the side. Connected with the handle is a lever, which operates a chain attached to a valve in the supply-cistern, and furnishes a definite and adequate quantity of water for flushing purposes. The trap being compactly arranged as a part of the apparatus, there is no intervening space to become soiled with the discharges, which the copious flush of water carries into the soil-pipe. The crown of the trap above its connection with the soil-pipe is provided with an opening for the attachment of a ventilating-pipe. The annexed diagram (Fig. 152) gives a sectional view of one of the best closets of this class. The main disadvantage of this plunger-

FIG. 153.



LONG HOPPER-CLOSET WITH TRAPS.

FIG. 154.



SHORT EARTHENWARE HOPPER WITH FLUSHING RIM AND VENT-PIPE.

closet, and, in fact, of all closets with mechanical parts, is the liability to derangement of some of the movable parts.

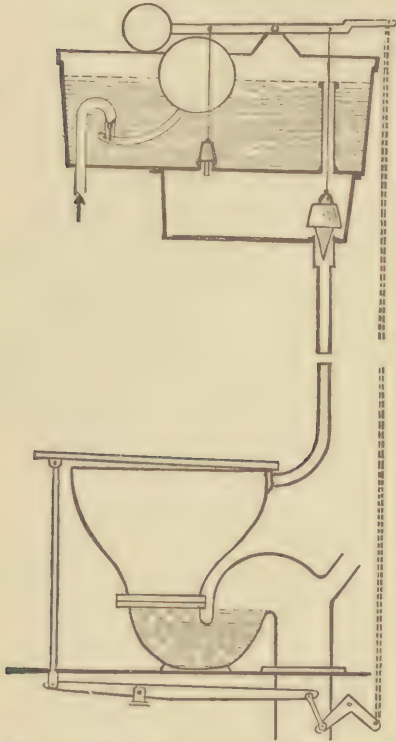
### The Hopper-Closet.

The simple hopper-closet consisting of a basin and trap without either pan or valve, or other complicated arrangements, if provided with an ample supply of water for flushing, and if well ventilated in the crown of the trap, is one of the

best of the cheaper kinds of closets. It is especially useful for outside closets, or for apartments well separated from the main part of the dwelling. There is no chamber to conceal the filth, and if the flush of water is ample and properly directed, the inside of the basin and trap

can be kept free from foul matter. The apparatus is not liable to get out of order, and is easily kept clear, as when any articles

FIG. 155.



SHORT HOPPER WITH WASTE-PREVENTION CISTERN.

of water, which should be admitted to the basin with a sudden dash, so as to sweep everything out of the trap. For this purpose tanks with waste-preventing chambers are provided, the discharge of water being obtained by pulling a chain, or by the automatic action of a lever connected with the seat. To insure an adequate discharge, the escape pipe should be at least one and a quarter inches in diameter.

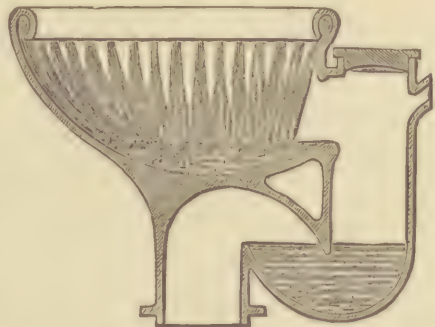
A short hopper-closet with automatic supply from a waste-prevention cistern is shown at Fig. 155.

The arrangement of an automatic supply is very necessary in this closet, as any neglect in the use of water will cause an offensive nuisance.

get into the trap they can be easily removed by the hand or by a wire hook. The flow of water is generally regulated by a valve connected by a lever with the seat. This form of closet is much used in factories, prisons, for out-door closets, and in poor neighborhoods. A form of long hopper with traps is shown at Fig. 153. With the long hopper the trap is placed under the floor, and is therefore hard to get at. Another disadvantage is the more extended surface exposed to fouling. The short hopper is therefore preferable, as it avoids both these disadvantages. A hopper of this description manufactured by the Mott Iron Works, is shown in the annexed diagram (Fig. 154). A flushing-rim for distributing the water admitted through a one and a quarter inch pipe from a flushing cistern, and a vent-pipe for the trap, are provided in this closet.

With the hopper-closet it is most important to have a copious supply

FIG. 156.



PATENT WASH-OUT CLOSET.

### The Washout-Closet.

The desirability of having a closet which shall be free from all mechanical parts, and in which the force of the water, on its entrance, shall remove the contents of the basin, has lead to the invention of the so-called washout-closet. In this apparatus the outlet from the basin is not at the bottom as in the ordinary closet, but at one side or at the back, and the flush of water from the rim is directed principally from the side opposite the outlet, so as to wash out the basin as thoroughly as possible. One form of this closet, that shown in Fig. 156, has the basin so constructed as to hold only a small quantity of water, and a syphon trap beneath the basin cast in one and the same piece of earthenware. There is a disadvantage in this closet which must be noticed, namely, that the flush may not be sufficient to cleanse the entire apparatus, its force being largely exhausted in washing out the bowl. Foul matter may thus lodge in the trap and in the vertical pipe between the bowl and the trap, from which offensive odors may be given off. It is therefore very important to obtain a powerful flush for the satisfactory cleansing of all the parts.

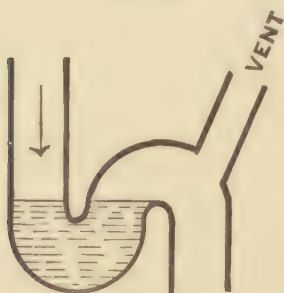
In another form of washout-closet, the basin itself is so arranged as to form one arm of the trap, and holds water to a considerable depth (Fig.

FIG. 157.



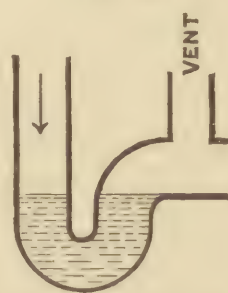
WASH-OUT CLOSET WITH BASIN AND TRAP COMBINED.

FIG. 158.



LEAD S TRAP WITH VENT.

FIG. 159



LEAD P OR HALF S TRAP WITH VENT.

157). Greater cleanliness of the basin, and freer access to the trap, are thus obtained: while the full force of the water is exerted in sweeping the contents of the bowl rapidly away.

Both of these forms of closets dispense with the overflow-pipe and other complicated parts, which are liable to get out of order, and they therefore



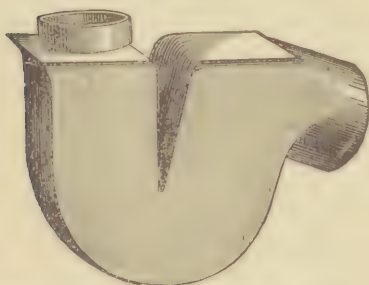
possess one of the most essential features of a good closet, namely, simplicity of design.

### Water-Closet Traps.

Closets in which the trap is not cast or moulded in one and the same piece of ware, require a trap to be fixed under them. The simplest and best form is the ordinary syphon, or S-shaped trap, which is of circular section, and free from angles or corners to harbor filth. The drawn lead traps, or Du Bois traps, are made by machinery and are without seams, and for this reason are superior to hand-made lead traps. These traps are made with the outer arm bent in various directions, and are designated as S,  $\frac{3}{4}$  S, and P, or  $\frac{1}{2}$  S traps, according to curvature of this arm (Figs. 158 and 159). The crown of the trap should always be ventilated, to prevent syphonage, and keep the branch-pipe free from foul gases.

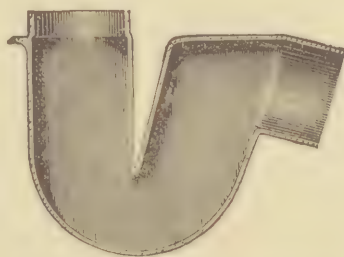
Mr. Hellyer's mansion trap resembles somewhat the ordinary S trap, except that it is a square-pipe trap with a round outgo (Fig. 160 and 161.) It is made by hand, and has soldered angles. It is claimed for it that it

FIG. 160.



HELLYER'S MANSION WATER-CLOSET TRAP.

FIG. 161.



SECTION OF HELLYER'S MANSION TRAP.

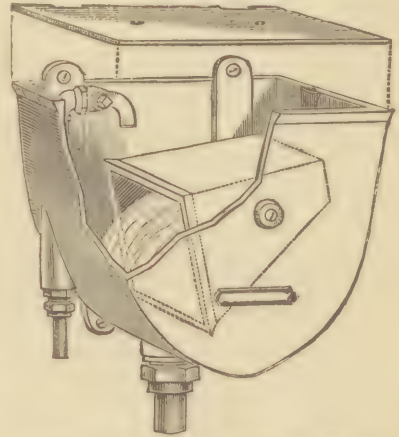
checks syphoning action and allows for evaporation, an important particular when a closet is not in constant use. It is said to be self-cleansing in its action, and particularly well adapted for valve-closets in which the discharge is sudden and direct into the trap. For ordinary purposes, however, the common S trap will be found to be most satisfactory to use.

Special precautions are required in making the junction of the closet with the trap, and of the trap with the soil-pipe, perfectly air-tight. The method of joining a lead with an iron pipe has already been pointed out. In joining the outlet-pipe of an earthenware closet, it is customary to spread out the mouth of the lead trap, or branch-pipe, so as to receive the base of the closet, and then to fill up the space with red-lead putty, and to dress the flange near the base with the same material. A flange of India-rubber is sometimes used.

### Automatic Flush Tanks.

For flushing closets, waste-preventing cisterns are now made in great variety, and in some form or other should be invariably used. It is not permissible to flush a closet by a branch taken direct from the service-pipe. Even if it were not a dangerous practice, the insufficient flush by this method would be a great objection to it. Several of these cisterns have already been shown on previous pages. Overflow pipes from a water-closet cistern must discharge into an open sink, or outside the house; but never into a water-closet bowl, soil, or waste-pipe, or into a drain or sewer. Automatic flushing tanks are also used, and are especially well adapted for urinals, outside water-closets, and closets in public places, or where there is a liability to neglect in flushing the apparatus. The McFarland automatic flushing tank (Fig. 162) may be taken as a sample of this style of apparatus. It is simply a bucket hung in a cistern working on brass journals. It is self-filling, and when the bucket is full it tilts at once, and empties its contents at once, and gives the closet a thorough wash. This tank is said to be anti-freezing, which is an advantage when used for outside closets. The intervals of flushing can be regulated at will, by adjusting the faucet so as to discharge a greater or less amount of water.

Fig. 162.



McFARLAND AUTOMATIC FLUSHING-TANK.

Fig. 163.



MOTT'S HYGEIA CLOSET, WITH OPEN SEAT.

### The Open Arrangement of Fixtures.

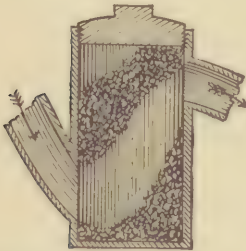
Water-closets, and fixtures generally, are usually enclosed in wood-work, and the various parts of the apparatus concealed from sight. This plan not only favors the accumulation of dust and dirt, and conceals from view any accidental spilling of slops,—which may give an unpleasant odor to the closet,—and more serious deficiencies, but it prevents the

required inspection and makes repairs expensive and difficult. It is very certain that if enclosures were entirely dispensed with, cleanliness would be greatly promoted, and any defects be much more easily detected and remedied. There is, of course, a great prejudice to the open arrangement of fixtures; but it is without reason, as the fixtures can be fitted up in a neat manner, without presenting an eye-sore. To show how unobjectionable this arrangement is, we furnish an illustration of a closet fitted up with an open seat of plain, black walnut with bronzed, iron legs (Fig. 163). The floor and back of the closet are set in white tiles, which aid in keeping the place clean, and add to the appearance. Wash-stands, bath-tubs, and other fixtures may be fitted up in the same neat manner.

### Stationary Wash-Stands.

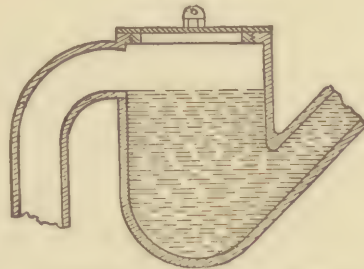
Stationary wash-stands, properly located in the bath-room or lavatory, and quite out of place in the sleeping apartment, should be fitted up in the open style, with everything under the slab exposed to full view. The basin should be made of porcelain, made either of the round or oval shape. Ordinarily, the basin is closed at the bottom with a plug and chain, and has a hidden overflow-pipe. The bowl is provided with a socket and coupling, to which the waste-pipe is attached. The objection to this form of bowl is the liability of the chain and the concealed

FIG. 164.



OBJECTIONABLE FORM OF BOTTLE TRAP.

FIG. 165.



IMPROVED FORM OF BOTTLE TRAP.

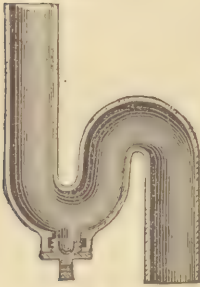
overflow-pipe to become fouled with soapy matters. To overcome this annoyance, various modifications have been made in the manner of closing the basin, most of them being in the arrangement of a waste-valve instead of a plug, and, in some cases, dispensing with the overflow. Weaver's wastes and Moore's no-overflow basin are illustrations of these two forms. Tip-up basins do away with plug and chain, and overflow, which is an improvement so far as it goes, but the lower bowl is apt to become foul. If the wash-bowl is made to lift out, all the parts can be cleansed. None of the basins described are without the objection of fouling of the concealed parts.



### The Trapping of Wash-Bowls.

Lead waste-pipes used for wash-bowls are in most cases one and a quarter inches in diameter. They should be trapped as near the bowl as possible, and the trap should be properly ventilated. The overflow-pipe

Fig. 166.

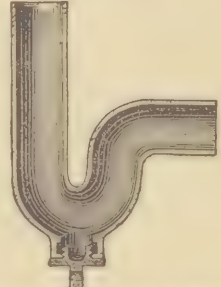


LEAD S TRAP.

must enter the arm of the trap next the bowl. This precaution is often ignorantly set aside, and the overflow-pipe made to act as an open channel between the waste-pipe and the room.

The drawn lead S-traps (Figs. 166 and 167), are the best traps for wash-stands. A cap and screw is attached to the bottom of the trap for cleaning-out purposes. A form of trap very frequently used

Fig. 167.

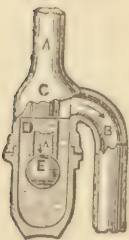


LEAD P OR HALF S TRAP.

for the wastes from different fixtures is the round or "bottle" trap. It holds a considerable quantity of water, and is not easily deprived of its water-seal. It is provided with a screw-cap for inspection and cleaning. If the trap is frequently cleansed, it will prove very serviceable; but, as a rule, the cover is rarely removed, and putrid deposits form in the manner shown in Fig. 164, and convert the trap into a cesspool. By rounding of the angles, as shown in Fig. 165, the trap is more likely to keep clean.

A great many mechanical traps have been devised with the object of affording absolute protection against the admission of foul gases. Among these may be mentioned the Bower trap, Fig. 168, which has had an extended use based on intrinsic merit. It has a double check, namely, a water-seal, and a ball, which presses against the mouth of the outlet-pipe when the water ceases to flow. A represents the inlet-pipe, and B the outlet-pipe. The escape of gas into the room is barred, first by the body of water in the cup C, and secondly, by the air-ball E, which presses firmly against the smooth, concave surface at the end of the inlet-pipe A. The ball-valve fits all the more tightly when the back-pressure is increased. The cup C is provided with a rubber gasket, so as to make an air-tight joint. It is easily detached for the purpose of cleaning the interior of the trap.

Fig. 168.



THE BOWER TRAP.

### Bath-Tubs.

Bath-tubs are usually made by lining a wooden box of proper shape with tinned copper. This form of tub requires to be cased in with wood,

which is always an objection. Iron bath-tubs, lined with porcelain enamel, are made to stand free from the floor, and are very satisfactory. They have one drawback arising from the scaling off of the enamel, which in time is sure to occur.

The porcelain bath, moulded and glazed in one piece, is, without doubt, the best bath that has been put upon the market; but the weight and expense are obstacles in the way of a more general use of this excellent form of tub.

The bath-waste should be at least two inches in diameter, to allow the bath to be rapidly emptied. A separate trap, well ventilated, should be used for the bath, and its waste-pipe should never connect with the trap of the water-closet. The ordinary overflow-pipe, on account of its length, becomes offensive. The ordinary plug and chain are likewise difficult to keep clean. To avoid these objections as much as possible, the standing waste may be used and the overflow-pipe, chain and plug done away with.

#### Housemaid's Sinks.

Housemaid's sinks are fixtures which require the greatest attention, as they are very liable to become offensive. They are made of porcelain-enameled iron, or of earthenware, the latter being preferable, as the enamel is liable to crack and chip off. Provision should be made for flushing the basin, and it is also necessary to fix a brass grating beneath it, to prevent objectionable articles from getting into the trap and waste-pipe, and choking them up. The trap should be at least three inches in diameter, and well protected with an air-pipe to prevent siphonage. Hot and cold water should also be provided.

#### Slop-Sinks.

Slop-sinks are often fitted up in dwellings for disposing of the chamber-slops. It is not advisable to multiply the number of fixtures, but if such a sink does not exist the slops are apt to be thrown into the bath or water-closet. It is highly necessary that slop-sinks should be copiously flushed after use, otherwise they will become offensive. A small cistern, operated by a chain and pull, should be fixed over the sink. The same precautions with regard to the use of a suitable strainer, trap, and vent-pipe, are required as in the case of the housemaid's sink. When the slop-hopper is dispensed with, the water-closet seat is fixed on hinges, and the seat beneath it is covered with lead, or, what is preferable, with a stone-ware or slate top, so as to prevent fouling of the place with the slops.

#### Kitchen Sinks.

Kitchen sinks are most generally made of iron, enameled, galvanized, or painted. None of the forms is entirely satisfactory. The enamel cracks and falls off, while the galvanizing wears off; paint must be constantly

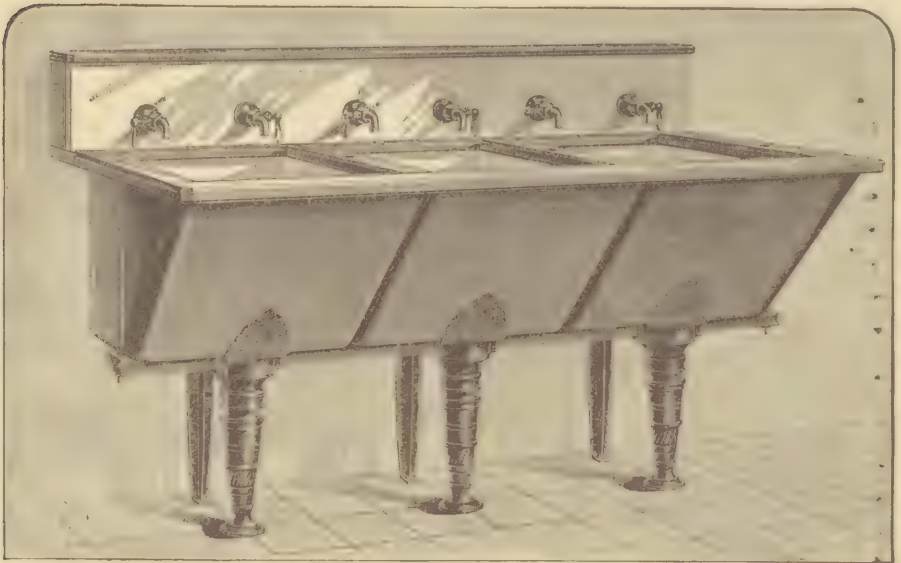
renewed. Soapstone sinks are preferable, but they become discolored in time and have a greasy appearance. The earthenware or porcelain sinks now being introduced in the market are the neatest and best sinks.

The kitchen sink being generally on the basement floor, the overflow-pipes can be omitted. The S-trap, well vented, will afford ample protection against the admission of drain-air. Kitchen wastes may be lead into the house-drain, or they may be taken into the area sink, the mouth of the pipe being over the trapping-water. A waste-pipe and trap, each one and a half inches in diameter, will be adequate in most cases.

### Laundry Tubs.

Laundry tubs fitted up in a stationary manner are made of impervious material, such as soapstone, cement, or porcelain. The English porcelain tubs, now largely imported, leave nothing to be desired in the way of

FIG. 169.



MOTT'S PORCELAIN WASH-TUBS SET ON LEGS.

neatness, cleanliness, and satisfactory use. They are rather expensive, and this is a reason why they may not be generally adopted. The annexed illustration (Fig. 169) shows a neat manner of fitting up these tubs without an enclosure. The back is of marble, and is perforated for the hot and cold-water faucets. The floor is of tiling, which presents a neat and cleanly appearance. One trap will suffice for a series of tubs; the trap and waste-pipe should be at least two inches in diameter in order to



take advantage of the large body of water in flushing the drain. An overflow-pipe is not necessary, unless the laundry is located above the basement floor.

### **Pantry Sinks.**

Butler's pantry sinks are made of sheet metal, preferably of tinned and planished copper. The overflow-pipe, which becomes offensive in time, may be dispensed with by using a standing waste. Lead and porcelain are sometimes used; the latter is very clean and attractive, but with its use the danger of breakage of crockery is greatly increased. Traps and vent-pipes must be provided in the usual careful manner.

### **Refrigerator Waste-Pipes.**

The waste-pipe of a refrigerator should under no circumstances be connected with a soil or waste-pipe, or with a drain or sewer. It may lead into a movable basin or pail, which can be emptied as occasion may require; or it may empty into a tray connected with a well trapped and ventilated waste-pipe, which should be provided with a tightly-fitting stop-cock, to be opened only for discharging the tray.

### **Other Methods of Removal of Excreta.**

When sewers do not exist, the question of the proper disposal of solid and liquid refuse matters becomes a very serious one. For the disposal of excreta the cesspool or privy-vault, or some one of the dry methods, is resorted to; but the house-slops are not so readily gotten rid of. In towns the open gutter is commonly used, while in the country and in villages the slops are thrown upon the ground. Privy-pits and cesspools should never be permitted in closely-built villages, certainly not in populous cities. If permitted as temporary conveniences, their construction should be governed by the most stringent regulations. They should be located as far from the house as possible; they should be perfectly water-tight, of small capacity, and regularly cleaned at frequent intervals by the odorless method. Their use should not be permitted for anything but excreta. In towns and villages the proper remedy for these nuisances is the construction of a well-planned system of sewers.

### **The Simple Pail System.**

The simple pail system has been used with advantage in England, but in the United States this method has not been systematically adopted. It consists in the removal of excremental matter at short intervals before it has become offensive. As a means to this end movable receptacles are used, "which systematically, at short intervals, are to be changed, clean for dirty, by the scavenger; and which, for the prevention of nuisance in this process have close-fitting, air-tight lids, to be applied to the foul

pails under removal." The excrement is removed daily without admixture, except with the ordinary kitchen refuse, and is transported outside the town.

### Dry Systems.

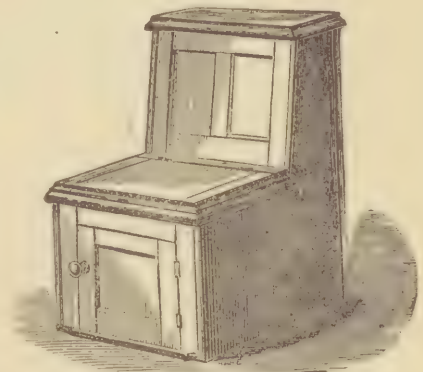
The dry system is adapted to towns and villages and to single cottages. It consists in the admixture of dried earth, coal ashes, or other dried refuse, with the excrement in sufficient quantity to absorb and reduce it to an inodorous form. The absorbent material must be perfectly dry, and must be applied immediately, and in sufficient quantity to cover the excretions and remove all fluidity. All slops and sink water and solid matter must be carefully excluded. In rural districts, this plan can be made very satisfactory; but in towns it is seldom that the removal takes place sufficiently often to meet the requirements of the case. The receptacles should be made of impervious materials, and the closet should be located either out-of-doors, or in an isolated part of the building, or in an apartment projecting from the house. The apartment should be well ventilated.

The dry method is a convenient, economical, and efficient means of excrement removal where water-closets cannot be made use of. For country-houses, villages, small towns, this plan is a most desirable one.

### The Earth-Closet System.

Moule's earth-closet system comes under the head of the dry-removal systems, and is the plan with which the public are most familiar. On account of the absorbing and deodorizing qualities of dried earth, this substance is selected for use in closets, especially within the house. The original apparatus, designed by Mr. Moule, consists of a wooden box divided into two main compartments (Fig. 170). The lower one contains a receptacle or pail for the sewage, and the upper one, the reservoir or hopper from which the dried earth is supplied in requisite quantity whenever the closet is used. The mechanism is explained by Fig. 171. The hopper in the upper part of the apparatus is capable of holding an ordinary coal-scuttle full of earth. A plug is attached to its outlet, and is operated by a lever connected with a handle. Beneath the seat is a guard, which directs the dried earth into the pail without allowing any of it to escape at the sides.

Fig. 170.



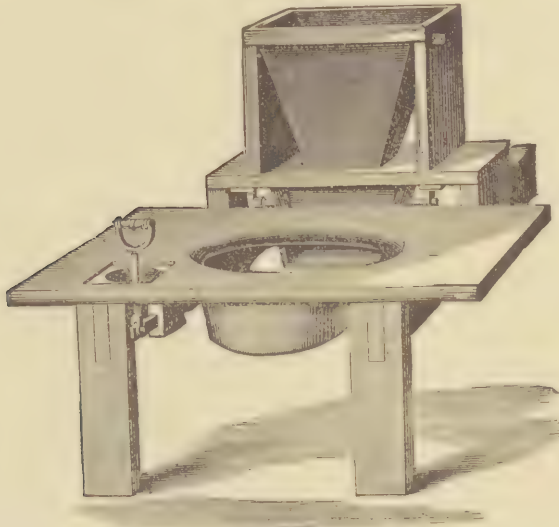
THE EARTH-COMMODE.

This simple form of earth-commode is adapted for use in a room. A fixed apparatus for general use requires a modification in plan, but the principle is the same. When such an apparatus is used, it should be located away from the living rooms in a well-ventilated apartment. The ash-closet system is similar to the earth-closet system, screened ashes being used instead of dried earth. In the country, a very simple and efficient plan is to raise the cottage privy above the ground, and provide an opening in the rear for the removal of the water-tight tub or box. A quantity of dried ashes or dried earth may be kept within the house. A small shovelful of this material thrown over the deposit each time will destroy all odor, and thoroughly disinfect the mass. The material should be removed at frequent intervals and applied to the land, as it is valuable in this state as a fertilizer. There are other modifications of this system, but it is unnecessary to refer to them in this place.

#### The Disposal of Slop-Water.

In the country, the slops are very commonly thrown upon the ground, where they are absorbed and pollute the soil with their nastiness; or they are carried away in open channels or in closed channels to some distant

FIG. 171.



MECHANISM OF THE EARTH COMMUNE.

part of the premises, where they gradually soak into the soil; or they are collected with the general sewage of the house in cesspools provided with porous walls, with the object of permitting the fluid parts to drain away, while the solid contents are removed upon their accumulation. To obviate all these nuisances, the best plan is to provide a tight cesspool with sufficient capacity for one or two days' collection, from which the

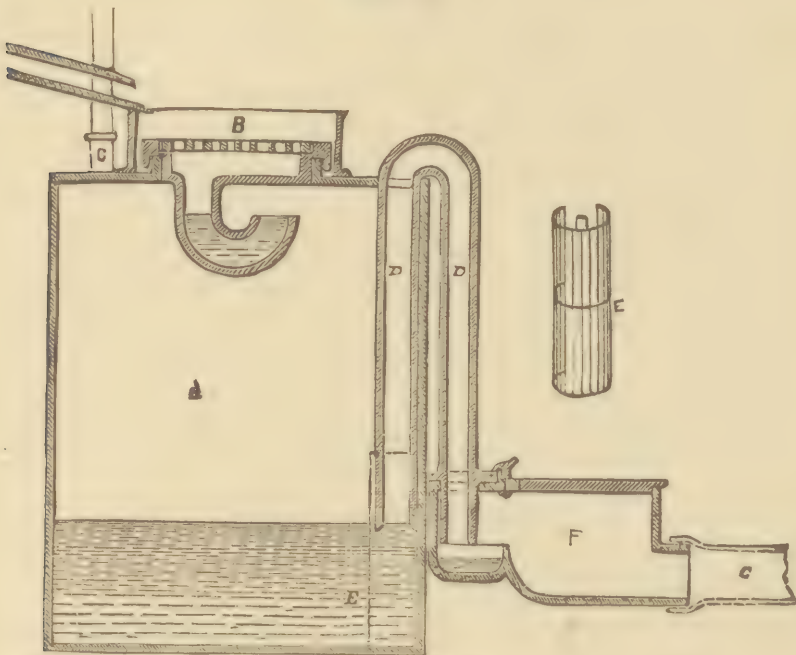


sewage may be distributed to the land by means of pipes under the surface of the ground. This is the plan of *sub-irrigation*, which is very convenient for the disposal of the sewage of separate houses, or groups of houses, where land is available.

### Sub-Surface Irrigation.

Sub-surface irrigation may be used for the disposal of slops alone or for slops mixed with the contents of water-closets. It is necessary, however, to provide a means for intercepting all solid and fatty matters, which should not be discharged into the drain-tiles, as they would, in time, clog up the pipes and render the system inoperative. Solid excre-

FIG. 172.



FIELD'S FLUSH TANK.

mental matters may be disposed of in a cleanly manner by the use of the earth-closet, and only the slop-waters be allowed to flow away in the sub-soil drains. The success of this plan depends on the property of the soil of destroying organic matter by the aid of the oxygen contained in its pores, and, to some extent, upon the action of the rootlets of grass and plants. All soils are not adapted for this work. Loose, sandy loam gives satisfactory results; but a clay soil may be used, with the precaution of applying a system of deep land tiles to carry off the clarified water that settles away, and which, if not afforded an outlet, would render the land wet and swampy.

The slops or sewage are collected in a tightly-cemented and well-ventilated tank, from which they are discharged into a cemented, vitrified pipe, carried to a point twenty-five feet or more further away. At this point the pipe is connected with a series of open-jointed drain-tiles, placed about ten inches below the surface of the ground. Whenever the tank becomes full, its contents are discharged by opening a stop-valve, the liquid flowing out with a rush, and entering all the ramifications of the drain-tiles. It is very necessary that the flow should be intermittent, both for the sake of flushing the pipes and for enabling the soil to admit the air, which could not occur if the fluid was continuously discharged into it. To secure an intermittent flow, automatic discharge-tanks have been made use of with satisfactory results. Field's flush-tank (Fig. 172) is the one most commonly used. It consists of a cylindrical iron tank, A, with a trapped inlet, B (which also forms a movable cover to give access to the interior of the tank), and an opening, C, which is used for a ventilating-pipe. The outlet D consists of a syphon so arranged that no discharge can take place until the tank becomes full, when the syphon is brought into action, and the contents of the tank are immediately discharged. A strainer, E, is placed on the inner end of the syphon, and on the outer end there is a discharging-trough, which connects with the line of outlet-pipes, G.

When only slop-water is discharged, the tank may be used by itself; but, if the water-closet wastes are also to be disposed of, it will be necessary to make use of an intercepting chamber placed between the house and the tank. Such a chamber, in which the solids settle, should be cleaned at frequent intervals, and the matter applied to the soil. The trapping and ventilation of the drain between the intercepting chamber and the house should be properly attended to.

#### Removal of House-Refuse.

There is not much difficulty in the disposal of dust, ashes, and kitchen refuse-matters in the country; but in large towns the removal of house-refuse is an important matter for consideration. The regular and frequent removal of these substances would relieve householders of annoyances to which they are very frequently subjected. The ash-barrel is often improperly made use of as a convenient receptacle for all kinds of refuse, kitchen-garbage included. Under the circumstances, these receptacles become very foul, particularly in warm weather. This practice, never to be advised, would not be so objectionable if a daily removal took place; but when these receptacles are allowed to stand for days at a time, nuisances are sure to be created.







*A Practice Spurt.*

# PHYSICAL EXERCISE AND CULTURE

CONTAINING

Practical Advice and Instruction on the Acquirement of  
Health and Strength by Systematic Exercise.

INCLUDING

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ARM, LEG, AND BODY MOVEMENTS; CONSTITUTING A  
PROGRESSIVE COURSE IN CALISTHENICS AND  
IN SWEDISH LIGHT GYMNASTICS.

AND SHOWING THE

## BENEFICIAL EFFECTS OF EXERCISE

UPON

THE VARIOUS ORGANS OF THE BODY AND THE GENERAL HEALTH.

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BY

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## INTRODUCTION.

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### The Importance of Physical Exercise.

THE advantages which the possessor of an educated mind enjoys in the great battle of life are so great and so manifest, that for centuries of our present civilization mental culture was the chief object of the schools, and instructors apparently forgot that the body was, equally with the intellect, capable of improvement, and when thus improved was an essential condition of perfect manhood. Of late years, however, thanks largely to the labors of Maclaren in England, Ling in Sweden, and Sargent in our own country, popular opinion has begun to realize the vital necessity of developing the corporeal as well as the spiritual nature of man, by the aid of duly regulated exercise.

In the first period of man's life, that of growth, when, as already explained, the formative energy of the system is most active, the proper exercise of all the bodily powers is of the greatest value, because the degree of development attained at this epoch of existence is that which stamps the individual in after years, and usually renders him tall and robust or the reverse, for the remainder of his days. During this time it has been aptly taught that the primary duty of education is to make of each human being in the first place *a good animal*, and after the best bodily development has been secured, to build on it as a foundation a perfect brain with all its glorious intellectual capacities and attributes. Herbert Spencer extends this idea in the suggestion that to be a nation of good animals constitutes the first condition to national prosperity. Bodily strength has in every age and among all races been an object of ambition, and the story of Samson, as well as the fable of Hercules, show what a lofty place in popular estimation is accorded by both sacred and profane history to personal prowess. Among the Greeks the victorious athletes who won prizes at the Olympic games were highly honored, and when a contestant gained more than one of the five rewards at any particular Olympiad, his triumph was commemorated by a marble statue. Pindar relates that a certain inhabitant of Rhodes called Diagoras was present when his two boys gained all the five prizes awarded at the sixty-first Olympiad. When the names of the victors were announced, these young

men lifted their father upon their shoulders and carried him around the arena amid the shouts of the assembled spectators, which rang forth so loudly that the rejoicings were audible in the harbor of Patria some seven leagues away. Diagoras, however, heard nothing after being borne aloft in the strong arms of his victorious sons, for the gods had granted that the happiest moment of his life should be his last.

In primitive times, when aggression and defence were the leading social activities, bodily vigor with its accompanying courage were the most desirable qualities, and then education was almost wholly physical; mental cultivation being little cared for, and, indeed, as again in the feudal ages, often treated with contempt. But now that society is relatively peaceful, now that muscular power is of use for little else than manual labor, whilst social success of nearly every kind depends very much on mental power, education has become quite too exclusively mental. Instead of, as in former ages, respecting the body and ignoring the mind, we now respect the mind and ignore the body. Both these attitudes are wrong. We do not yet sufficiently realize that, as in this life of ours the physical underlies the mental, and, as it were, supports it, the mental must not be developed at the expense of the physical. Hence the ancient and modern conceptions must be combined.

Perhaps nothing will do so much to hasten the advent of the time when body and mind will both be adequately cared for in education, as a diffusion of the belief that the preservation of health is a *duty*. Few seem conscious that there is such a thing as physical morality. Men's habitual words and acts imply the idea that they are at liberty to treat their bodies as they please. Disorders entailed by disobedience to nature's dictates they regard simply as grievances; not as the effect of conduct which is more or less profoundly immoral. Though the evil consequences inflicted on their descendants and on future generations are often as great as those caused by crime, they do not deem themselves in any degree criminal. It is true that in the case of drunkenness the viciousness of a purely bodily transgression is sometimes recognized, but none appear to infer that if this bodily transgression is vicious, so too is every bodily transgression against sanitary ordinances. The fact is, declares Mr. Spencer, all breaches of the laws of health are *physical sins*. Were this generally and fully realized, then, and perhaps not till then, would the physical training of the young receive all the attention it deserves.

Every human being at its entrance into the world comes with a certain stock of constitutional vigor, by which, if favorably circumstanced, it can attain to a definite share of health and strength, varying in each case with its degree of inherited vitality. This germ of perfectability, as it has been aptly called, is bounded at the best by a limit of development which can never be exceeded, but its growth may be so crippled by adverse influences, that the child never even approaches the standard of average

manhood. On the other hand, just in proportion as the surrounding agencies can be rendered less prejudicial, and more advantageous, will be the ultimate success of an individual in its struggle towards attaining that measure of complete mental and physical perfection, with the capacity for which it was primarily endowed.

Of all the environing agents which conduce to growth and development, that which is most capable of being permanently systematized and applied as a means of securing health by progressive bodily culture, is exercise. Bodily exercise should therefore be accorded a very prominent place in any study of personal hygiene, not only on account of its own value, but because it is so much more liable to be misunderstood, misapplied or neglected than many of the other influences which conduce towards obtaining a perfect organization in perfect action for each individual of our race. From necessity the chief questions in regard to ventilation, food and clothing, are more or less familiar to ignorant and careless members of the community, and although with a majority of persons the action of deteriorating causes may not be clearly comprehended, the evil results are evident and immediate. Hence, when hygienic errors are committed, they arise either from some inevitable hindering influence, or else from willful violation of laws about which ignorance cannot be pleaded. Thus, for example, the inhabitant of a crowded city knows perfectly well that it would be better for him, and especially for his children, to constantly inhale the pure air of the country, but his occupation pitilessly determines for him the place of his abode. Again the insufficiently fed operative is fully aware that it would be better for him and for those dependent upon him, to have an abundance of nourishing food, and yet poverty restricts him and his family to a meagre diet. In either case the individual commits the fault with his eyes open and whilst fully awake to the fact that he is incurring the heavy penalty of a deterioration of health. But this is not the case with errors in regard to exercise, the nature and influence of which are greatly misunderstood or doubted altogether, notwithstanding the fact that they are quite as real, as serious, and sometimes no less direct, than those which flow from disobedience to hygienic laws respecting any other factor of health.

Exercise may be defined as muscular movement produced by muscular contraction, the power by which indeed every motion of the living organism is accomplished. This power of contractibility, with which muscular fibres are endowed, is to some extent described by its name, being the capacity of contraction or shortening the distance between their two extremities. The entire muscular system is made up, as already explained, of involuntary and voluntary muscles, and the methods of effecting movements by these latter are pointed out on page 621. It is, of course, the latter class of muscles, those under control of the will, which are chiefly concerned in physical exercise.



Although exercise may be described as muscular movement, in the ordinary acceptation of the term, this motion must be rapid and forcible enough to engage the energetic contraction of the muscles employed. Since every operation of the muscles or nerves involves the death and disintegration of a certain minute portion of their substance, it is obvious that a second process of repair of tissue must be quickly called into action to replace that loss, or else the body would rapidly diminish in size and strength, and life itself would shortly cease. This reparative process is accomplished, as pointed out on page 155, by the constantly circulating blood, which brings the fresh material to take the place of that which has been worn out. The rapidity of this rebuilding operation ought, of course, to be in exact proportion to the activity of the process of disintegration during energetic use of the part employed, and since the strength of the developed human body, and of each portion of that body, is found to be greater in accordance with its youth or newness, the hastening of these two compensative processes of destruction and reconstruction in our bodies is a most important element in securing a high degree of physical power.

Exercise, whether laborious or recreative, under which are included the systematized movements of gymnastics, proves beneficial in three ways:

1. It increases the size and power of the voluntary muscles judiciously brought into play.
2. It augments the functional capacity of the involuntary muscles employed.
3. It promotes the health and vigor of the entire body by increasing respiration and quickening the circulation of the blood.

These three advantages of active muscular movement are very closely dependent upon each other, for a necessary accompaniment of the rapid destruction of the cell elements of voluntary muscles by exercise is an increased energy of the circulation of the blood in those muscles, for the purpose of removing the effects of physiological wear. This increased activity of the circulation, says Prof. Flint, the distinguished physiologist, is attended with an augmented activity of the nutritive processes, provided the supply of nutriment be sufficient, and provided also that the exercise be succeeded by a proper period of rest. It is in this way only that we can comprehend the process of developing muscles by training; the conditions in training being exercise, rest following the exercise, and appropriate alimentation, the food furnishing nitrogenized matters to supply the waste of the nitrogenized parts of the tissues. This theory involves the idea that muscular work consumes a certain part of the muscular substance, which is repaired by food. The hypothesis that the muscles simply transform the elements of food into force directly, these elements not becoming at any time a part of the muscular substance, is not in accordance with the facts known with regard to training.

All that is known, on the contrary, with regard to the nutrition and dissimilation of muscles during ordinary or extraordinary work, teaches that such work is always attended with destruction of muscular substance, which may or may not be completely repaired by food, according to the amount of work performed, and the quantity and kind of alimentation supplied.

The influence of general muscular movement upon the human body as a whole will be more correctly appreciated if we now consider its effects upon the various organs and their particular functions.

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## CHAPTER I.

### EXERCISE OR PHYSICAL DEVELOPMENT.

Whilst the heart, the hollow muscle which propels the blood to all parts of the system is constantly in operation during life, exercise can most powerfully modify its action for good or ill to the entire organism. Every one can perceive for himself that exercise drives the blood more forcibly to the skin, as is seen in the heightened color of the cheeks caused by more red blood flowing through the small arteries and capillary networks, such as are shown in the figure, and the quickened pulse following muscular exertion. The increased heat felt whilst engaged in brisk exercise is also a proof of quickened movement of the blood, and augmented exchange of material in the tissues which it supplies. Moreover, it is a well-known fact that exercise increases the appetite, thus indicating a want of new constituents in the blood. But besides these evidences, which every day experience offers us, of the power possessed by bodily exercise in accelerating the circulation, there are many convincing theoretical proofs of the same fact.

Contractions of the large muscles, especially those of the arms and legs, produce a more or less powerful pressure on the blood-vessels which penetrate or are contiguous to them. The effect of this pressure is different on the arteries from what it is on the veins, on account of the

FIG. 173.



A NETWORK OF CAPILIARIES.

difference which exists in the walls of these two sets of blood-vessels, and the valves with which they are supplied. The arterial walls are much firmer and endowed with a far higher degree of elasticity than are those of the veins, and hence the blood is under greater pressure in the former than in the latter, at ordinary times. The great aorta, as shown in the figure on page 478, is supplied with three valvular flaps at its origin out of the left ventricle of the heart, arranged so as to hinder the blood from flowing back into the cavity of that organ. Hence muscular pressure upon arteries tends to promote the flow of blood *onward* towards the capillaries, thus favoring in some slight degree the progress of the vital fluid in its course over the round of the circulation. Such aid, however, is far less important than that afforded by muscular pressure upon the veins, which, having much softer and thinner walls, allow their fluid contents to be easily influenced by external pressure. Hence the energetic muscular contractions of active exercise have a very powerful effect in promoting the return flow of the blood towards the heart, especially since many of the veins being furnished with valves, reflux of the current towards the capillary networks of the body is cut off. Moreover, by movements of the limbs, such as bending, stretching, and so forth, the extensible veins are alternately shortened and elongated, and these operations act with a kind of sucking force upon the blood within. The outer coats of the veins also adhere at certain places, especially near the joints, to overlying tissues, and are raised by certain motions so that the diameter of the vessel becomes enlarged, a circumstance which likewise contributes to suck, as it were, the blood towards the heart. From all these facts it appears that the influence of ordinary muscular movement upon the flow of blood to the heart is by no means inconsiderable, and in proportion as the muscular contractions of active exercise are comprehensive, and include all parts of the body, can a powerful effect upon the circulation be produced.

Furthermore, it is possible to regulate by movements the supply of blood to each particular organ in such a way as to accomplish special results. Thus, for example, undue afflux of blood to an impaired organ, when its superabundance might prove dangerous, can be relieved by appropriate movements, so calculated as to carry the blood to parts where it causes no harm. In certain forms of heart disease passive motions, and particular varieties of active movement, may be beneficially employed in such a way as to send the blood to the exterior portions of the body, and so relieve cardiac congestion without adding any strain to the action of the muscular substance of the heart.

#### **Action of Exercise upon the Lungs.**

The importance of a powerful respiration, by which an ample supply of fresh, pure air, rich in oxygen, is taken in, and much waste matter



given off, is evident from what has been said in a previous chapter on ventilation, for example on page 106, where the lamentable story of the Black Hole of Calcutta is narrated. Deep and calm is preferable to rapid and superficial breathing. The latter method of inspiration is inefficient, and is a sign of weakness, whereas profound and regular breathing indicates well developed respiratory organs. During and for some little time after active exercise, respiration is both frequent and deep, so that the augmented quantity of air inhaled and again exhaled carries with it a vastly increased amount of oxygen on the one hand, and of carbonic acid with other waste products on the other. A wide, deep and mobile chest is well known to be a sign of strength in the organs of respiration, and is usually well exhibited in vigorous soldiers, sailors and laborers, and still more in those who make use of gymnastics in a rational manner. Such men contrast most favorably with the narrow and almost motionless chests of those who lack the advantages of developmental medicine, and in consequence of sedentary occupation or deficient energy of will, are deprived of the necessary amount of bodily exercise. Respiration also contributes to secure the proper circulation of the blood. If left to themselves the lungs would by no means fill the cavity of the chest, but during inspiration the air rushing through the air-tubes expands them, and keeps them pressed close against the inside walls of the chest, which is widened, as we have previously pointed out, by the operation of muscles concerned in the process of breathing. In consequence of the great elasticity of the substance of the lungs, they react upon the pressure of the air inside of them, and tend to shrink from their surroundings. This produces a diminished pressure of the air within the lungs upon the heart and great blood-vessels, which lie within the chest between and behind the pulmonary organs, and consequently a suction of the blood in the large veins towards the heart. If the walls of the arteries and the arrangement of their valves were the same as in the veins, this sucking force would be equal in each set of blood-vessels, and the circulation would be retarded in the former as much as it is accelerated in the latter. But, as stated in a former section, the blood is under great pressure in the large arteries, on account of the high degree of elasticity of their coats, whereas the pressure is very slight in the veins because their walls have but little contractile power. Besides the walls of the arteries are firm and resist the suction, whilst those of the veins are flexible and easily yield to it. Finally the semilunar valves at the commencement of the aorta are shut whenever the outward current of the blood propelled by the heart's contraction is not flowing rapidly, whilst the veins being provided along the inside with valves which open in a direction towards the heart, there is no hindrance to the influx of blood by the venous conduits. The consequence of all this is, that the diminished pressure on the heart and large veins described above powerfully promotes the rapid

emptying of blood from the veins into the heart, but has little effect on the circulation in the arteries. Briefly, then, exercise develops the muscles of respiration, and by the energetic action of these strengthened muscles the entire circulation is invigorated, and a more active exchange between the blood and inhaled air is effected. Exactly as a strong current of air keeps up a brisk fire, supposing there is an ample supply of fuel, powerful respiration stimulates the functions of the bodily organs, and thus accelerates the renewal and elimination of material in all parts of the body, supposing, of course, that there is a sufficient provision of food.

### **The Influence of Exercise on Digestion.**

The beneficial effect of exercise in developing the muscular system can only be secured, as intimated in the preceding paragraph, by an abundant supply of food, and hence the relations of exercise to the digestive organs are very important. A due amount of active muscular movement seems to be an indispensable condition for securing healthy digestive organs and an easy digestion. As already pointed out, one very serious form of dyspepsia is due to feebleness of the muscular movement of the stomach, and although this churning motion is produced by broad, thin muscles which are not under the control of the will, yet it is probable that the involuntary muscles partake with the voluntary in their development to a great extent. In fact anatomical observation has shown that strong abdominal muscles are generally found with good digestion, and, on the contrary, that weakness of these muscles is apt to be accompanied by feebleness of the digestive powers. It has also been proved that movements which cause the abdominal muscles to contract strongly have a strengthening influence upon the organs of digestion, and this is, in some measure, explained by the fact, that contraction of the muscles which are dependent upon the will, call forth sympathetic contractions of the involuntary muscles, as may be seen in the pupil of the eye. Practically it has been found that appropriate bodily exercise not only contributes that best sauce to food,—hunger, as every one knows—but also that it largely aids in developing and preserving a strong and efficient digestive apparatus.

### **Influence of Exercise on the Processes of Secretion.**

The blood, it will be remembered, is not only the great carrier of liquid material to the organs which select out and manufacture from it the secretions, such as the gastric juice and the saliva, but it also takes up a large amount of the waste products of the tissues, which are cast off in the excretions of the lungs, the skin, and the kidneys. The rapid and complete throwing off of these waste matters is no less important for the preservation of health than is an abundant supply of appropriate food. Muscular exercise increases the activity of the circulation and the



pressure of the blood, especially in the more minute arteries, thus causing an augmented transudation of nutritive material to fill the interspaces of surrounding textures, whereas it diminishes the blood pressure in the smaller veins, thus facilitating the absorption of the effete products from the interspaces of the tissues. In the same way the decreased pressure of blood in the minute veins favors the absorption of a larger quantity of nutritive material, and thus renders the vital fluid richer and more vitalizing in its properties. Within certain limits this rapid disintegration and equivalent renewal of the various bodily structures, is an important factor of the most abounding health, and just as under ordinary circumstances a merchant's profit is great, in proportion as his business is brisk, so does a human body gain in strength and development, in proportion as a rapid and duly balanced exchange of material is secured by proper physical exercise.

#### **Influence of Exercise on the Organs of Movement.**

The fact that exercise has a marked effect upon the organs of movement is so apparent, that we almost all instinctively draw inferences at a glance, from the condition of the muscles of the limbs, not only as to the physical power of the individual, but in regard to the state of health as well. Every one knows that prolonged action tires the muscle which is brought into play, the weariness, as pointed out above, largely resulting from a waste within its substance, by the breaking down of the muscular elements endowed with contracting power. But the fatigue, when not too intense, disappears after due rest, in consequence of the used up material which clogs up, if it does not poison, the muscle, having been removed. Now, as is shown in the familiar example of the blacksmith's arm, movements do not diminish the volume of a muscle, but, on the contrary, increase it, if applied within due limits. This shows that new substance has made good, and more than made good, the worn out material, and corroborates the general statement that muscular action promotes increased growth by accelerating the circulation and augmenting the absorption of nutritive material, the demand for which in turn manifests itself by improved appetite. Muscular action, as well as the increased heat accompanying it, are forces developed at the expense of the nutritive material, but these are the very agencies which cause the muscles to gain in bulk and strength, provided these latter are supplied with sufficient nourishment from rich blood, and provided also there are due intervals of rest. If these two conditions are not secured, however, the muscles will not be able to absorb the necessary nutriment, and instead of augmenting in bulk would begin to dwindle away. Appropriate exercise is not only necessary for the natural development and the rapid renewal of the muscles, but also for the strengthening of the passive organs of movement, such as the bones and the ligaments which go to



make up the joints. The importance of strong and healthy organs of motion for the duties of life in general, but more especially for the preservation of health, is evident from the fact that it is possible to influence through the action of the muscles, not only the regenerative processes of the organism as a whole, but also the regeneration of any special portion of the body when diseased.

But the development of the organs of movement may be carried beyond the limits of real health, since a perfect hygienic condition requires, as already explained, an exact harmony and equilibrium between the different organs and functions of the system, and it is an undeniable physiological fact that excess in the development of one organ eventuates in weakness of some other, as is often seen in acrobats and athletes, ultimately to the serious detriment or destruction of health. But thus it is with all good things that are used to excess, and yet the fact does not deprive them of their qualities of goodness and usefulness when employed with judicious moderation.

#### **Influence of Exercise on the Nervous System and Mental Life.**

There is an obvious difference as regards the condition of the nerves between working men of all descriptions—in towns as well as in the country—and the classes of society which more or less lack bodily exercise. The former may often suffer from various disturbances of health, but *nervous*, in the medical acceptance of the term, they very seldom are; whereas a more or less developed nervousness is exceedingly common among those who, on account of the nature of their occupations, or from any other reason, do not daily subject their muscles to a sufficient amount of exercise. This weakness of the nervous system usually manifests itself by a great susceptibility and sensitiveness to both external and internal impressions. Common every day noises, or an ordinary amount of light produces painful impressions; changes of temperature are keenly felt. Moreover, headache, faceache, pain in the back, and other forms of neuralgia, with dyspepsia and palpitation of the heart, are very frequent companions to this nervousness. In some cases the antagonistic condition of a blunted sensibility producing a certain dullness of mind, is the obvious manifestation of an overwrought nervous system. These two opposite characters of the disease are also displayed in the movements under control of the will, either on the one side as an unnatural irritability, such as a tendency to paroxysms of crying, laughing, cramp or convulsions, from slight exciting causes, or as a weakness or numbness in the organs of movement, as well as in the organic functions generally. Not less characteristic of this state of nervousness is the psychical condition, as displayed by an irritable and unsteady temper, a want of energy and enterprise, or a lack of perseverance in the pursuit of any desired object.

There are of course many circumstances that may act as contributing causes to nervousness, and it is no exaggeration to say that our civilized life, both in private and in society, tends in various ways to exaggerate this debility of the nervous apparatus. The system of education most in vogue, with its one-sided tendency to operate exclusively upon the intellectual faculties, produces too often this weakness of the nerves and ganglia, as a direct consequence of overstraining them and not allowing due rest for their proper nutrition and repair. How much of this injurious over-exertion is strictly mental, and how much is physical, is no easy thing to decide, and it should be remembered that mind and body continually affect each other, it may be to the detriment of health as well as to its advantage. The faculties of judgment and reasoning, which should be the guides of mankind, under both the gay and the sad vicissitudes of life, will never arrive at or retain their perfection in an individual burdened with a diseased or irritable nervous system. Such a man is more apt to nourish within himself a morbid sensitiveness, a misdirected imagination, which readily lead to general weariness and indifference towards the practical every day struggles of human existence, or to doubt as to the higher destinies of man. Surely no one who has studied the influence of our modern social life can consider it calculated to consolidate judgment, or augment the lucidity of the understanding, nor capable of hardening or bracing a weakened nervous system. But it is the deficiency of appropriate muscular exercise which is one of the principal causes of nervousness, for it has been proved by microscopical investigation that a nerve left in prolonged inactivity undergoes a degeneration which gradually annihilates its power of action, and even daily experience shows how relaxed and enfeebled a nerve becomes through want of active use.

In justly estimating the dangers of too great mental and insufficient physical education in early life, it must be remembered that the strong will and untiring activity, which result from abundant animal vigor, go far to compensate for even great defects in book-knowledge, and when conjoined with that fairly adequate education, which may be obtained without sacrificing health, they ensure an easy victory over competitors enfeebled by excessive study, prodigies of learning though they may be. What "boots" it, exclaims Mr. Spencer, to have attained wealth, if that wealth is accompanied by ceaseless ailments? What is the worth of distinction if it has brought hypochondria with it? Surely it needs no argument to prove that a good digestion, a bounding pulse and high spirits are elements of happiness, which no external advantages can out-balance. Chronic bodily disorder casts a gloom over the brightest prospects, while the vivacity of strong health gilds even misfortune. Over-education of the mental faculties to the exclusion of due physical culture, is vicious in every way, "vicious as giving knowledge that will soon be



forgotten; vicious, as producing a disgust for knowledge; vicious, as neglecting that organization of knowledge which is more important than its acquisition; vicious, as weakening or destroying that energy without which a trained intellect is useless; vicious, as entailing that ill-health for which even success in intellectual pursuits would not compensate, and which makes failure doubly bitter."

One of the strongest pleas in favor of due physical education for girls is that put forth by Herbert Spencer in the following eloquent passage which should be carefully pondered by every instructor of the female sex. Out of the many elements uniting in various proportions to produce in man's breast that complex emotion which we call love, the strongest are those produced by physical attractions; the next in order of strength are those produced by moral attractions; the weakest are those produced by intellectual attractions; and even these latter are dependent much less upon acquired knowledge than on natural faculties such as quickness, wit and insight. If any deem the assertion a derogatory one, and inveigh against the masculine character for being thus swayed, we reply that they little know what they say when they thus call in question Divine ordinations. Even were there no evident meaning in the arrangement, we might be sure some important end was subserved. But the meaning is quite obvious to those who seek it. It needs but to remember that one of nature's ends, or rather her supreme end, is the welfare of posterity; it needs but to remember that in so far as posterity is concerned, a cultivated intelligence, based upon a bad physical organization, is of little worth, seeing that its descendants will die out in a generation or two; it needs but to bear in mind that a good *physique*, however poor the accompanying mental endowments, is worth preserving, because generally speaking, throughout future generations the mental endowments may be indefinitely developed; it needs but to contemplate these truths to see how important is the balance of instincts above described. But purpose apart, the instincts being thus balanced, it is a fatal folly to persist in a system which undermines a girl's constitution that it may overload her memory.

In order to render the vital influence of bodily exercise upon the nervous apparatus more clearly understood, let us consider an example illustrating the part played by the nerves in the performance of movements, and the relation of the nervous system to other organs. When we bend the forearm upon the arm at the elbow, this is effected by an impulse of the will, produced by means of a peculiar action in the nerve-cells of the brain, which impulse is conducted to the muscles through certain motor nerves, with a rapidity of about one hundred feet per second. As this takes place we are sensible of the action of the muscles, and this indicates that there is also a nervous impulse carried in an opposite direction: that is, from the arm to the brain, where it becomes a "sensation." Thus both the nerve-centres and the peripheric or external



nerves are brought into active operation. If now we continue the observation further, we shall see that the circulation of the blood also is influenced, so that a more abundant supply of renewing material is brought to the active nerves, as well as to the active muscles. And we know that the whole economy of the blood is essentially affected by increased expenditure, as well as by increased income of its life-giving constituents. That is to say, the respiration grows more powerful, the process of digestion more complete, and the secretions increase. Thus muscular movements put the nervous system into operation, and by this other organs and groups of organs are stimulated to action. A manifold reciprocity of excitement is brought about between the peripheric nerves and their nerve centres, through the so-called reflex movements, explained on page 418. As the nervous action is brought about by forces, which in order that life shall continue must not become exhausted, but must be continually kept up, it follows, as a matter of course, that the nervous exertion must be in proportion to the supply of renewing material. Physical as well as mental over-exertion, must be avoided if the nervous system is to be preserved in health and strength. But it follows from the purely physiological laws alluded to, that *appropriate* muscular exercise, operates in a stimulating and invigorating way on the nervous system, in regard also to mental work. The nervous apparatus, and more especially the brain, is the organ of the mental powers. If there is a continued supply of healthy blood to the brain, the grand physical condition for energetic intellectual activity is sustained, so far as individual capacity admits. Hence, just as the perfection of physical life is dependent on proper exercise of function by the various organs, so the mental capacities in a healthy body are kept up to their highest point of efficiency, by the moderate and appropriate employment of all the functions concerned in their manifestation. The functions of the different organs being intimately connected with, and dependent on, each other, a disturbance in any one has a disturbing influence upon others, but the organism re-acts and succeeds in overcoming a great number of such derangements, many of which it does not even become conscious of. If it was not for this power of re-establishing itself, each human being would soon succumb to the pernicious influences, which assail it on every side, and this power of vital reaction in every organism may be powerfully reinforced in many ways, by rational muscular exercise through the manifold beneficial effects upon the various organs and system of organs, as above described.

Gymnastic exercises, either with or without apparatus, such as are now taught in most large cities, and we rejoice to say in many of the best equipped institutions of learning of the United States, are the grand means for inducing busy or lazy people to contract their voluntary muscles frequently enough and forcibly enough to secure health.

Our first record of physical training, that is to say of any regular system

adopted and practiced with the single view of cultivating the physical powers, is to be found in the competitive exercises of the early Greeks and Romans, and enthusiastic admirers of antiquity have asserted that we have lost as much by the discontinuance of the organized methods of bodily exercise, in vogue among the war-like inhabitants of Greece and Rome, as we have gained by all the discoveries of physiological science. The extent, the importance, and the value of the system of bodily exercise practiced by the Greeks and Romans can be accurately estimated, for we know exactly of what it consisted, and for what purpose it was organized and maintained. But it is only by the light of physiology, which has, at a comparatively recent period, revealed to us what exercise really is, that we can justly judge of the efficacy of the methods employed.

It is remarkable indeed, that the system of training devised for the athletes of old times, contrived, as it was, by men almost entirely deficient in true scientific knowledge, should have succeeded in so perfectly accomplishing the end in view. The wonderful success attained, however, was secured by a close and careful investigation of results. The acute observers of antiquity soon noticed that the strength of the body, and of any part of the body, was in proportion to its muscular development, and that this development followed upon and bore a constant relation to its activity or employment. They did not know that the innumerable atoms or cells of which the human body is made up, have each their period of birth, maturity and decay, and that the strength of the organism, as a whole and in each of its parts, is in proportion to the youth or newness of these individual cell-elements. They simply observed that the increased bulk, strength and energy of the organ or limb, was in relation to the amount of its use, and they gave it employment accordingly. This occupation for the organs or muscles was made energetic enough to demand a large and increasing amount of resistance, the endurance of profound and vastly accelerated breathing without distress, and the production of profuse purifying perspiration, which was further promoted by reducing the clothing to the smallest amount decency would permit. On account of this latter circumstance their system received the name of gymnastics, a term derived from the Greek word signifying naked.

Thus, then, were the ancients guided by the observation of results, with sufficient accuracy in the comprehension of the chief features, and in the estimation of the relative value of certain modes of bodily exercise. By this means were they able to choose on assured grounds those evolutions which were most suitable for the method which they desired to originate. They sought a system specially applicable to individual culture and individual excellence, one which would foster personal courage, presence of mind and decision, and one which afforded the widest scope for individual effort, and presented the fullest opportunities for personal display



and personal distinction. Hence, a lofty place was awarded to all exercises of high competitive effort, such as wrestling, boxing, throwing the discus, as well as racing on foot, on horseback, and in chariots. In fact the entire system was as simple, as practical, and as serviceable as the Greek shield or the Roman sword.

This system of physical training had for its chief object the practicing of the young Greeks and Romans in all the exercises tending to qualify them for the exigencies of battles as they were then fought, and war as it was then pursued. But in those days, as in our own, there were doubtless men, albeit comparatively few, who were the unhappy possessors of unsound constitutions, whether from original weakness of organization, or from illness, accident, neglect or other causes. For these no provision was made in the plans for physical education, contrived by the training masters of antiquity, whose system was adapted only to develop still more the brave, the active, the swift, and the strong.

Our knowledge of physiological science gives us something vastly more valuable than their's. A system of bodily exercise which will give added strength to the strong, and increased dexterity to the active, is not alone what is now needed. On the contrary, it has been aptly observed that the crowning evidence of the Divine origin of all true knowledge is, that whilst benefitting everyone within its influence, it benefits most bountifully those whose needs are the greatest. In our days, as of old, the race is still to the swift and the battle to the strong, but the battle of life now is waged with the brain for its weapon, and the race is a high-pressure competition of memory and of mind. At the present time it is health rather than strength, which is the chief want of man in the nineteenth century. Even among the few who take upon themselves the hardships of military life, brute force is not now the most valuable quality. But other occupations make as urgent demands upon bodily power, activity and stamina, for the endurance of protracted fatigue, as ever were pressed upon the soldier in ancient or modern times. From the nursery to the school, the college, and thence to the great world beyond, the brain and nerve strain goes on continuously augmenting. Examinations, scholarships, promotions, speculations, long hours of work, late hours for rest, jaded frames, weary brains, and jarring nerves, each intensified by and intensifying the disturbance of the others, demand in modern times the antidote to be found alone in physical action. These are the exigencies of the campaign of life for the great bulk of our youths, to be encountered in the school room, the study, the court of law, the hospital, and the day and night visitation to fever-stricken courts and alleys, and the hardships are just as exhausting, and destroy life just as mercilessly, as do the toils and the exposures of actual warfare.

Robust health rather than gigantic strength is therefore the great requirement of men of the nineteenth century in their modern occupa-



tions. It is not the power to march vast distances, transport ponderous burdens, raise enormous weights, or overcome great material obstructions, which is needed. It is simply that condition of body, that amount of vital capacity, which will enable each man in his own social position to pursue his calling, and labor on in his working life with the greatest amount of comfort to himself and usefulness to his fellow men. How many we see around us who, though earnest, eager and uncomplaining, are pursuing their avocations with the prospect of a certain break-down ever imminent before them; or who accomplish their allotted share of the world's work in weariness, languor and depression, when fair health and full power might have been secured, and the labor which is now performed imperfectly and with suffering, might have been discharged with completeness and in comfort.

It must not be supposed that health and strength are here considered as in any degree opposed to each other; they are, on the contrary, most intimately allied, and usually obtained by the same means. Still a man may possess either without the other, as, for example, vast strength of limb may be found united to a comparatively feeble trunk, or great muscular force may accompany delicate lungs. These each reveal local power associated with local weakness, a combination of qualities which is incompatible with perfect health. By all means then let each boy or man cultivate strength in every available way, but let it be universal, not partial, strength. The battle of life requires its combatants to be in every instance a *whole* man, not merely a part, and that whole individual in order that he shall win one of the grand prizes in the conflict, must be in the best possible condition for the struggle.

There is, says Maclaren in one of the most eloquent passages of his admirable work on physical education, no calling or occupation in which man can be engaged, there is no position in life, no circumstances in which he may be placed, in which a fairly developed frame will not be valuable to him. There are many of these positions, even the most purely and highly intellectual, in which it is essential to success; essential simply as a means, material, but none the less imperative to enable the mind to do its work. Year by year, almost day by day, we see men falter and fail in the midst of their labors; men to whom labor is life and idleness is death; men who with a negation of self and of self-comfort, even unto martyrdom, devote themselves to great purposes and great works, and before their completion fail; men who run their course with feet winged with the purest faith, and hearts filled with the noblest hope, and who perhaps with the goal of their lofty ambition in view, falter and fail by the wayside, and all for want of a little more bodily stamina, a tiny share of additional physical power and capacity for the endurance of fatigue, or protracted unrest, anxiety or grief.

The mind acts through a material organ, the brain, upon which for

its power of manifestation it is entirely dependent, and which, as so often insisted on in this book, is subject to a constant decay, and equally constant renewal, from the same blood which supplies the other tissues; these processes being accelerated within the skull as elsewhere, and the cerebral strength and vigor consequently augmented, in proportion to the mental activity. But in common with other organs also, if this activity of the brain is carried beyond certain limits, its waste exceeds nutrition, and its strength gives place to weakness. The mind then is dependent upon the blood, and its perfect action is dependent upon its receiving an adequate supply of the healthy circulating fluid. Moreover, the organ of the mind being subject to the same laws as the other organs, requires similar alternations of rest and action to maintain it in its natural state of efficiency, and if either of these conditions be deficient or in excess, the brain, and consequently the mind, will deteriorate. Hence, if the cultivation or exercise of the mind be neglected, it will of necessity be weakened in precisely the same manner that the other organs of the body, such as the lungs, are debilitated by insufficient use, deteriorating both in strength and vigor, and also in the power of enduring fatigue. If, on the other hand, the exercise of the brain be excessive, surpassing the limit when the nutrition is equal to the waste, it will suffer in precisely the same way, and to the same extent perhaps that the other organs would do.

Exercise, as distinguished from laborious occupation, may be classed under two heads, Recreative and Educational, and since human beings in highly civilized life are artificially prevented by the demands upon their mental powers from taking the due amount of physical exercise, natural and healthful in the out-door existence of the savage, an artificial substitute for open air labor has been contrived. The conditions of civilization, especially in large cities, preventing natural spontaneous exercise, and the evil effects of no exercise becoming conspicuous, a system of factitious exercise or gymnastics has been substituted. It is maintained by the great philosopher Herbert Spencer, that the defects of the substitute are both positive and negative. In the first place, he declares these formal muscular motions as usually practiced are necessarily much less varied than those accompanying juvenile sports, and hence by not securing so equable a distribution of action to all parts of the body sooner induce fatigue, and if constantly repeated lead to disproportionate development. Secondly, the quantity of exercise thus taken will be deficient, in consequence of lack of interest in it. Even where not made repulsive, as they sometimes are to young persons by assuming the form of appointed lessons, these monotonous movements are very apt to become wearisome from the absence of amusement. Competition, it is true, serves as a stimulus, but it is seldom a lasting stimulus like that of the enjoyment accompanying varied play. Moreover, this want of enjoyment is in itself



a disadvantage, since any agreeable mental excitement has a highly invigorating influence. The common assumption that so long as the amount of bodily action is the same, it matters not whether it be pleasurable or otherwise, is quite a mistake. The truth is, happiness is the most powerful of tonics. By accelerating the circulation of the blood it facilitates the performance of every function, and so tends to increase health when it exists, and to restore it when it has been lost. Hence the essential superiority of play to gymnastics. The extreme interest felt by children in their games, and the riotous glee with which they carry on their rougher frolics, are of as much importance as the accompanying exertion. And as not supplying these mental stimuli, gymnastics are for many persons fundamentally defective. For girls, as well as for boys, the sportive activities to which their instincts impel are essential to bodily welfare and perfection, and parents and guardians should remember that whoever forbids them, forbids the divinely appointed means for securing complete physical development.

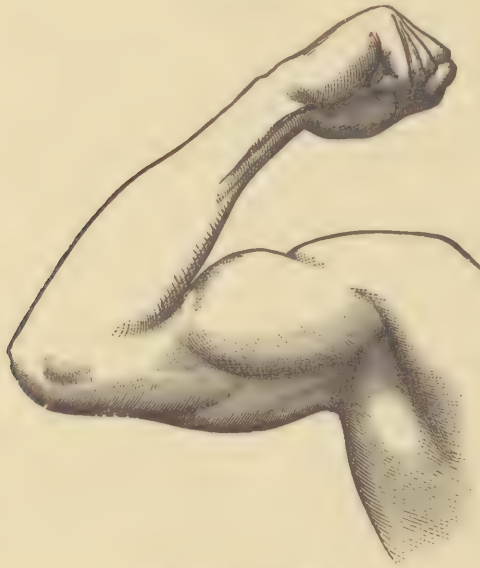
But, on the other hand, it may, with good reason, be urged that out of this very stimulus which pastimes in all their varieties afford, arises not perhaps an evil, but a defect. The parts of the body which are called upon to execute the movements of such exercises, are those which can perform them the best, not those which need them the most. Use gives facility of execution, and facility of execution invites frequency of practice, because we all like to do what we can do well. Hence almost inevitably certain parts of the body will be cultivated, and undergo development to the exclusion of the others. So certain is this to be the case, that it is often easy for an expert to tell from the general development of a youth what recreative exercise he has practiced when at school. It will be found that the lower limbs and right arm have the lion's share of the employment or exercise, in almost every one of the ordinary recreative exercises. As a necessary consequence these portions of the body have the lion's share of the resulting strength and development. Recreative exercises then, from their very nature, are inadequate to produce the uniform and harmonious development of the entire frame, because the employment which they give is essentially partial. Where the activity is, there will be the development, and if the lesson inculcated by deductions from this principle be overlooked, a portion of the body only will be cultivated, and the neglected part will fall far behind the others in strength, dexterity and endurance, for the simple reason that it will be less abundantly nourished. Whilst, therefore, recreative exercises in sufficient amount would, as a general rule, be sufficient to maintain the health and strength in an individual after growth and development are completed, they do not most efficiently meet the many wants of the rapidly changing and plastic frames of youths spending a large portion of their time in constrained positions during long hours of study. Hence the



necessity that sports and pastimes, invaluable as these are, should be supplemented in most human beings, during the period of growth at any rate, by organized methods of educational exercise. It is the office, as it is entirely within the reach of systematized exercise, to modify the growth and distribute the resources of the body, so that each particular portion shall receive and assimilate its legitimate share of the nutritive elements, also to so increase these resources that every part of the growing frame shall have its wants supplied.

Probably the chief reason why systematized exercise is not appreciated at its full value, is that its special nature and object, its susceptibility of gradation to meet the requirements of every individual, and its effect upon the different structures of the human frame, are imperfectly under-

Fig. 174.



A WELL-DEVELOPED MUSCLE.

stood. This arises from the fact that its effects upon any part but the muscles, are seldom taken into consideration, and hence its vast influence on the organs employed in the vital processes of respiration, circulation and nutrition, as already pointed out, is overlooked. The evils arising from this mistake are manifold and increasing, because so long as it is popularly believed that systematized exercise gives nothing but muscular power, few of those engaged in purely intellectual pursuits, to whom such power would be comparatively valueless, would care to cultivate it, even could they do so without effort; and fewer still would give to it that effort which its attainment demands.

But if it can be proved that this muscular power is but one result of systematized exercise, and that when properly adjusted its influence can

be brought most beneficially to bear upon the other systems of the body, and especially upon the important structures which encase such vital organs as the heart and lungs, and condition their health and functional ability, it becomes as valuable to the person who works with his brain as to the most ordinary handicraftsman. This will be the case, because just in proportion to an individual's intellectual ability will be the acuteness of his perception of the great truth, that in proportion as his organs of respiration, circulation and digestion, are healthy and vigorous, will be his chance of prolonging his mental labor with safety to himself and increased value to his fellow men. But such culture should be obtained in youth, during the period of the body's growth, when every organ and limb, every tissue and bone, are advancing to occupy their ultimate place in the frame, that is, whilst all is plastic and capable of being changed for better or for worse with great rapidity.

Once develop strong limbs and a shapely frame, and a very little exercise comparatively will keep them so. Get the vigorous heart and ample lungs, set in a fair proportioned and ample chest, and but a small fraction of the time spent in carefully regulated exercise will retain them in good condition. The portion of each day thus occupied need not be more than the busiest life can spare, nor in excess of that which the gravest mind would seek for recreation and recuperation. And that such results can be readily attained, may be demonstrated by reference to the recorded experience of leading teachers and disciples of the gospel of physical exercise. Such, for example, as the following: An official enquiry made several years since into the results of gymnastic exercises instituted at a military school in France, over a period of six months, established the facts that—

1. The muscular force is increased in that time on an average fifteen per cent., and occasionally from twenty-five to thirty per cent.
2. That the force has a tendency to become equal on both sides of the body, thus making it symmetrical.
3. That the capacity of the chest, and consequently the breathing powers, are augmented by one-sixth at the lowest.
4. That the weight of the individual is increased about seven per cent., and occasionally ten to fifteen per cent., while the bulk of the body is diminished, thus showing that the profit is confined to the muscular system, whilst superfluous fat is removed.

Prof. Blaikie, in his excellent little book entitled, "How to Get Strong," remarks, "You may take a man twenty-eight years old, tall and rather slim, where height has probably not increased a single hair's breadth in seven years, and in a few short months increase that height by half an inch; or again you may take another, also twenty-eight, and, suddenly as you may say, in the short period of five months add sixteen pounds to his weight, and every pound of excellent flesh. Now there are thousands

of men in our country to-day who would be delighted to make an equally great addition to their general size and strength, even in twice that period. To add five whole inches of chest circumference, and nearly that much of heart and lung and stomach room, consequently to gain this much greater capacity of all these vital organs, is a matter to many men of almost immeasurable value.

As Dr. Morgan points out, an addition of three inches in a man's chest circumference implies that the lungs instead of containing two hundred and fifty cubic inches of air, as they did before their functional activity was exalted, are now capable of receiving three hundred cubic inches within their cells; the value of this augmented pulmonary capacity will readily be admitted. Suppose, for example, a man is attacked by pneumonia, by pleurisy, or some of the varied forms of broncho-pneumonia,

FIG. 175.



A POORLY-DEVELOPED CHEST.

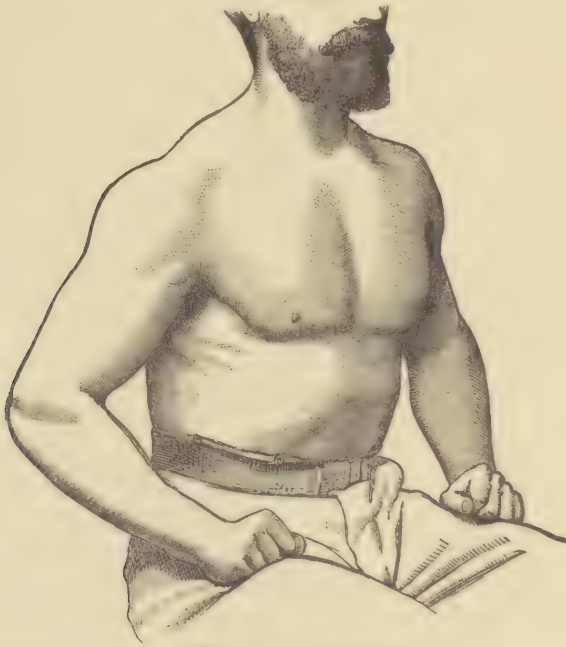
it may readily be conceived that in such an emergency the possession of enough lung tissue to admit forty or fifty additional cubic inches of air will amply suffice to turn the scale on the side of recovery. It powerfully assists the patient to successfully tide over the critical stage of his disease. A man then of feeble lungs (the consumptive for instance) taken early in hand, with the care which a truly hygienic master of gymnastics could afford him, would in a few months find that his narrow, thin and hollow chest had departed, and been replaced by a round, full, deep and roomy thorax, that the feeble lungs and heart, which in cool weather were formerly hardly capable of keeping the extremities warm, are now strong and vigorous; that the old tendency to stoop whilst sitting or



walking, with its disastrous effect in cramping the vital organs, is gone, and, in ten words, fifty per cent. is added to his chance of life.

Professor Blaikie thinks that almost any man under forty, even though he has been cursed with a thin, narrow chest, half-used lungs, and scrawny arms and legs, may in a few months, by systematic graded exercise, largely remedy this want of development; and he justly contends that careful employment of wooden dumb-bells weighing two and a half pounds each, or of clubs of three and a half pounds, or of pulley weights of ten or fifteen pounds, is not half so dangerous to the organism as a sudden run to catch a boat or train, taken by one who is out of the way of running, or who perhaps has never learned.

FIG. 176.



A WELL-DEVELOPED CHEST.

Professor Blaikie gives as a further illustration of the almost miraculous effect of exercise in obviating the tendency to consumption, the case of Dr. G., of Boston, who, as shown by a photograph of himself, taken several years previously had his shoulders warped forward, his chest flat, almost hollow, and his face and general appearance suggesting a delicate man. He said, indeed, that he was strongly inclined to be consumptive. By practicing breathing, however, not on an ordinary "blowing machine," where the lungs are emptied of all that there is in them, but on an *inspirometer*, from which instead one inhales every inch of air possible, and also by practicing vigorous working of his diaphragm, he had so expanded his lungs that he could inhale 380 cubic inches at one breath. Certainly

the depth of his chest at this later period was something remarkable, being apparently about fourteen inches through from sternum to spine, and a surprisingly broad chest as well. But the most astonishing feature in Dr. G.'s case was the tremendous power of his voice. He said that at the end of half an hour's public singing with opera singers, whilst they were hot and perspiring, he was just warming up and getting ready for his work. One thing all who ever heard him sing would quickly concede, namely, that seldom had they anywhere listened to such an immense voice. He also claimed to have run two blocks in a single breath. His appearance was, as might be supposed, as little that of a consumptive as could well be imagined.

After a man of weak lungs has thus built them up above par, and attained for them more than average vigor, he must, however, continue to exercise and invigorate them by systematic training lest they relapse towards their normally feeble condition. President Day, of Yale College, said to have been a consumptive at seventeen, by constant good care of his body, lived to be ninety-five, and it is far from uncommon for delicate persons, even if inclined to phthisis, who judiciously cultivate the small stock of vigor they have, to out-live sturdier ones who are prodigal and careless of their vital powers.

A famous example of the practical benefit of light gymnastic exercise is that of the venerable poet Bryant, who died at the advanced age of eighty-four, and wrote when he was seventy-seven: "I rise early: in winter, about half past five; in summer, half an hour or an hour earlier. Immediately, with very little encumbrance of clothing, I begin a series of exercises, for the most part designed to expand the chest, and at the same time call into action all the muscles and articulations of the body. These are performed with dumb-bells of the very lightest kind covered with flannel, with a pole, a horizontal bar, and a light chair swung around my head. After a full hour, and sometimes more, passed in this manner, I bathe from head to foot. When at my place in the country I sometimes shorten my exercises in the chamber, and, going out, occupy myself for half an hour or more in some *work* which requires brisk movement. Breakfast over, I occupy myself with study for a while, and then when in town, I walk down to the office of the *Evening Post*, nearly three miles distant, and after about three hours, return, always walking, whatever be the weather or the state of the streets. In the country I am engaged in my literary tasks, until a feeling of weariness drives me out into the open air, and I go upon my farm or into the garden, and prune the fruit trees, or perform such other work about them which they need, and then go back to my books. I seldom drive out, preferring to walk."

This plan of the immortal author of "Thanatopsis" may suit a large majority, but when one finds his digestion is disturbed by exertion before breakfast, as is often the case, such difficulty can generally be obviated by

following the French fashion and that of the English trainers, that is, taking a roll, or even a soda cracker, with a cup of coffee, perhaps (to stay the stomach, as it is popularly called), before commencing exercise.

### Evil Effect of Too Little Exercise.

The gradually-increasing failure of muscular power which is observable when neglect of proper exercise is persistent, is the result of microscopic changes in the structure of muscles involved, during which some of the natural contractile material disappears, and is in part replaced by powerless and inert fat. This change in the texture of any portion of the muscular system, tends, of course, to weaken the fibres, so that any sudden strain imposed upon it might cause them to tear across. Such an accident, which in many situations would be only inconvenient or distressing, may prove quickly fatal when it affects the heart. As pointed out in the article on cardiac diseases, the muscular substance of the heart may be thus in great measure converted into fat, and its tenacity so diminished in some one particular spot, that when the organ is urged on to violent exertion by some unusual effort, the weak place gives way and the individual dies of a broken heart. After middle life, when the period of

decay commences, it can readily happen that a muscle which has undergone fatty degeneration in consequence of long disuse, may give way in this manner, when called upon to perform some unusual feat. Thus, for example, a man of fifty, who, after years of sedentary life, makes an effort to throw a ball for a long distance, may be seized with a sudden sharp pain like the cut from a whip, and find the arm thus affected drop to his side entirely helpless. On examination, a surgeon discovers that the

Fig. 177.



BENT ARM SHOWING ACTION OF MUSCLE.

biceps, or large muscle on the front of the arm, has been torn across, in consequence of its weakened condition, the result of fatty degeneration. Perhaps the sufferer has not used his biceps muscle in a similar movement for twenty years previously, and this prolonged period of inaction has rendered it powerless for the work it is abruptly called upon to perform.

When, from any cause, the activity of a set of muscles is lessened, the whole group may waste and degenerate, and if the diminished activity, or may be complete inactivity, lasts long enough, the power of contraction may become permanently lost. A child with a diseased joint, as the knee, for instance, does not use the muscles to stir it on account of the



pain produced, and the consequence is, if the complaint continues for any great length of time, that the power of moving the joint, even after all disturbance in the knee has disappeared, may be forever lost. This failure of power in the muscles may occur in a whole limb, as, for example, in the arm, from too-prolonged use of a sling, or in the leg, from similar confinement to a bed or in splints. In this way, the efficiency of a whole extremity may be lost, and a withered limb, such as is so often seen, appears as the sad and pitiable result of a neglect of exercise in cases of this nature. One-half of the body may be affected with muscular wasting in long-standing paralysis, and the possibility of all muscular contraction disappear never to be restored. It is this fact which renders passive motion and electricity so important in the treatment of paralysis, as pointed out in its appropriate place.

In the case of an individual who habitually neglects due physical exercise, the consequences will in time infallibly manifest themselves in deterioration of his general health. The reader has already been reminded that when a muscle is brought into action, more purified blood is sent to it, and more impure blood is given out from it. To cause an acceleration of the rapidity in the circulation, the heart must beat faster and more powerfully: whilst, on account of the increased quantity of impure blood manufactured, the breathing becomes hastened to afford sufficient air to secure the due purification of the augmented current of blood through the lungs. It is a matter of every-day experience that when an untrained person runs for any considerable distance, he gets out of breath, and the heart can be felt on the left side thumping away against the ribs. A quickening of the heart's action, and of the breathing, occurs also to a slight extent when any bodily exercise is indulged in. When, however, a proper amount of physical exertion is avoided, the heart, having too little to do, becomes thinner and softer, and less capable of enduring any sudden and increased strain which may be thrown upon it. The lungs, in like manner, not being sufficiently expanded, in consequence of a habit of shallow breathing having been formed, any extra work imposed upon them during unaccustomed physical exertion, may result in permanent evil effects, such as dilatation of the pulmonary air-vesicles. This is the pathological condition producing what is called "broken wind" in horses, and what is popularly, though not very correctly, termed asthma in human beings.

There are many forms of imperfect growth, more or less serious in their nature, to be seen in every school, partly due to deficient exercise, which it is very important to remedy. These are nearly all capable of being rectified during this period of life by systematized movements. Among them may be particularly mentioned, pigeon-breast or undue prominence of the breast-bone, accompanied usually by flatness of the ribs in the upper region of the chest. Such a malformation may sometimes be

traced to prolonged attacks of hooping-cough or of bronchitis during childhood, associated with influences which interfere with the due solidification of the bones, by the deposit of mineral ingredients into their substance, as occurs in rickets. Occasionally, a hollowing-in of the breast occurs, and is due to similar causes. The remedial measures in each instance consist in the employment of such exercises as will be pointed out in the next chapter, for developing the lungs, expanding the chest, and invigorating the thoracic muscles generally. Care must be taken, however, to conjoin with this physical exercise the administration of such food and medicines as will correct the deficient deposit of bony material, and so strengthen the osseous frame-work, as has been directed in the article upon rickets on page 401.

One of the most common deformities among studious youths is stooping, by which is meant the habit of carrying the head and neck, as well as the upper portion of the trunk, bent forward, so that they are not in a line with the rest of the column of the body. A most evil consequence of this position is the compression, resulting in contraction, or at least imperfect development, of the upper part of the chest. With this kind of deformity may be classed, as a more exaggerated form, the various species of spinal curvature, often due to weakness of the dorsal muscles, or to inordinate or unregulated growth. Rapid growth in height, if unaccompanied by corresponding development, is not only a misfortune in itself, but the source of many other physical evils. Thus, for instance, we sometimes see lads at school, growing at the rate of six or eight inches per year. Even the smaller of these additions to height, if so rapidly attained, is incompatible with fair development and robust health, because the whole formative power of the body is expended in furthering one process—that of upward growth. A marked phenomenon of this rapid increase in height is the scanty expansion of the chest which takes place during the process. A boy or girl who has thus “outgrown his strength,” as it is frequently called, may exhibit a chest which runs up from the waist without any expansion whatever, whilst the shoulders fold round towards the front, and the head stoops forward from the base of the neck, the spinal column seldom retaining its natural erectness. The thorax has even been known to actually diminish in circumference, as if it were tightened up by extreme elongation of the general frame. The true cause of these displacements is often, if not always, to be found in neglect of proper exercise for the muscles, which hold the parts in their due relationship to each other. Dwarfed or stunted growth, and growing on one side, are distressing examples of imperfect development, which can often be cured or vastly improved by duly regulated exercise.

Maclaren declares that he has found almost every youth on entering the University (Oxford) has, as it were, a considerable amount of attainable power, and material capacity undeveloped; his body, or rather a



portion of it, is in arrears in this respect, and as the arrears of a recoverable debt, the youth may fairly view it. In fact, he may obtain a large installment of it almost immediately; for, it was found that during the first term of two months, with properly administered, systematized exercise, the chest would expand, under ordinary circumstances, two inches, and under special conditions, might increase in circumference double that amount.

The effects of over-exertion, or the *abuse* of physical exercise, are like the *abuses* of other excellent things, most sedulously to be guarded against.

Among young children the danger of overworking the muscular system is small, for until the spirit of emulation in competitive exercises or games is aroused, the child subsides when tired into rest and sleep, and so saves itself from any ill-results. When the period of youth is reached, however, the spirit of rivalry comes into play, and the will is brought to bear to urge on the exhausted muscles to excessive work. A lad, for instance, is spurred on by emulation to win a race, to throw his opponent in a foot-ball scramble, or to lift a heavier weight than he ought, and so perhaps brings on himself some incurable disease. Or a girl may be so stimulated by the applause of her companions, that she will persist in jumping a rope, for example, as has actually happened, until she falls dead on the spot. Many young girls persevere in piano-playing, painting, fancy needlework, and similar occupations, until the foundation of permanent ill-health is laid. They grow tired, by-and-by, it may be, become exhausted, but the task must be completed, and as soon as they have partially rested go to work again, with both mental and physical powers imperfectly recuperated. This continues perhaps day after day, and month after month, until changes occur in the shape of the spine, or disturbance of some vital organ sets in, and the work, alas too late, is perforce relinquished.

In case of any sudden muscular exertion, such as young men are called on to make in field sports, and in the ruder games and pastimes, the chief danger besides that of rupture is to the circulatory system. When a person braces himself to undertake some extraordinary feat of strength, he does so by taking a deep breath, fixing the diaphragm, the muscles of the thorax, and the muscles of the larynx or wind-pipe, so as to render the chest a rigid air-box. Should it be a leaping exploit which is to be performed, a short hundred yards race which is to be run, or indeed any extreme exertion which occupies but a short time, the gymnast hardly breathes at all during the act, and a severe strain upon the heart and blood-vessel system is the result. Even when a person goes up stairs quickly, or comes to a steep ascent whilst walking, the diaphragm is often contracted, the breathing thus impeded, and palpitation of the heart brought on. So with rowing, by many oarsmen the breath is held with each stroke, especially when the sudden effort of a "spurt" is called



for, and as a consequence rapid breathlessness and exhaustion make themselves manifest. In like manner during singing, public speaking, and preaching, breathlessness and fatigue will soon ensue, in persons who, not having learned how to properly perform these valuable exercises, commence by trying to make themselves heard by spasmodically contracting the diaphragm and the thoracic muscles generally.

It is with the results, however, of sudden or great exertion as it effects the circulatory system that we especially have to deal. In consequence of the breath being held during a severe muscular effort, the blood is delayed in its passage through the lungs. Not meeting with pure air it refuses to go on, and the venous system becoming congested the veins stand out prominently. The pressure thus produced upon the right side of the heart, which, as stated on page 158, is much thinner than the other, if frequently repeated is liable to lead to dilatation. Such a condition when once produced is apt to be permanent, and gives rise to many physical troubles, such as palpitation, distressing feelings of suffocation on any little exertion, dropsical swelling of the legs, and arrest of growth or general puny condition, if the youth is not fully developed before it makes its appearance.

Exhaustion of the cardiac muscle, and indeed of the muscles generally from overwork, is due principally to want of oxygen, brought to them to burn the carbonized elements which supply the force, and also from the accumulation of the products of their combustion. This condition of things is effected first by general fatigue of the nervous system, manifested especially on the heart, so that the blood circulates less vigorously, and the processes of renewal and removal, already described, are slackened. A muscle which has undergone exhaustion in this way has its nutrition seriously impaired, and twenty-four hours of overwork under the hands of an injudicious trainer will perhaps not be recovered from for days afterward. Muscular exhaustion or "acute local fatigue," as it has been called, manifests itself not merely in loss of power, but often in irregular, painful muscular contractions, cramps, tremors, and a peculiar muscular pain or soreness distinct from cramp and also readily distinguishable from other kinds of pain.

Sometimes, as mentioned earlier in this article, a sudden and violent exertion may result in snapping off some of the fibres of a muscle, such as those in the arm whilst throwing a ball, or those of the back whilst lifting a heavy weight. This accident is rare, except in persons whose muscles have undergone some fatty or other degeneration. It is attended by loss of power and sharp, severe pain, which may be followed by a good deal of inflammation of the injured part. Its treatment has been already indicated.

Excessive exertion in walking, running or leaping, is liable to bring on an enlargement of the veins of the legs, which gives rise to much

suffering, and, if the distended or varicose veins burst may prove immediately fatal or result in the formation of deep and painful ulcers, which may be very difficult to heal. For the management of varicose veins see page 488, but it is far better to avoid their production by observing the first tendency to yielding of the vascular walls and avoiding those exercises which are found to aggravate such a disposition.

Lastly, the production of hernia or rupture, described on page 547, during the performance of feats of lifting, of leaping, and so forth, must be carefully guarded against, especially by those in whom any hereditary tendency to this troublesome and dangerous malady can be discovered, on scrutinizing examination of the family history for several generations.

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## CHAPTER II.

# GYMNASTIC EXERCISE.

THE great principle which lies at the foundation of gymnastic exercises at the present day is that of developing some part or parts of the body by special movements or apparatus particularly adapted to that purpose. It is obvious that by a complete series of appliances all portions of the muscular system may be thus duly invigorated, and that a judicious distribution of the amount of exercise to each set of muscles will result in a harmonious development of the entire frame. In order to gain this desirable object, however, each individual aspirant for the benefits to be conferred must have not only his present condition, but his general tendencies as indicated by his own and his family history, carefully investigated. This should be done by a trainer of superior judgment and ripe experience, and his opinion should be based on his own observation and likewise upon a medical examination. In this way only can be remedied the partial development which results from the various avocations which require so frequently unilateral or local movements for their performance.

In devising any system of examination with a view of ascertaining the particular requirements involved in the proper care and development of the body by means of exercise, the object remains the same whether the plan is applied to a single individual or a large body, such as the students of a University. The aim is to establish in each case the present capacities of the individual by a series of measurements and tests of strength

taken in conjunction with his personal and family history, showing at the same time not only his absolute, but also his comparative vigor, demonstrating his points of special weakness, and indicating, therefore, the direction in which he most needs development. Our recreative and competitive sports, while of the greatest interest and value, do not always supply these desiderata for the student. On the contrary, he is too apt under their stimulus to aim at developing himself in precisely the direction in which he least needs it. Having a powerful back and loins he goes into the boat crew, or being especially strong in the lower limbs he takes up walking, running or leaping. Such men, naturally athletic and fond of exercise, need to be guided and directed, sometimes to be restrained; others of sluggish temperament or of studious and scholarly habits, must be encouraged and stimulated, but all require to have their work, whether spontaneous or compulsory, directed into proper channels, so that the result will be a harmonious and symmetrical development of the entire organism.

The plan adopted for determining exactly what is necessary in each individual case, by Prof. J. William White, Director of Physical Education in the University of Pennsylvania, is an improved modification of that long in use at Oxford, England, and more recently introduced into Harvard and a few other American colleges.

Each student is stripped and carefully examined as to his weight, height, the circumference of his chest, the size and condition of his legs, thighs, arms and forearms. The sum of all these measurements, expressed in any convenient terms which may be selected, centimetres or feet for example, is taken as an approximate indication of his development. It indicates, that is, with more or less accuracy, the amount of working material which he possesses, but it altogether fails to show the actual working value of that material. It was for years almost the only standard applied in the primary selection of competitors or participants in athletic sports, when they were chosen, as in colleges, from large numbers of candidates as representative athletes. It has long been known, however, as a matter of experience, that if we have, for instance, two men weighing respectively 150 and 175 pounds, the smaller of these may be able to exert a much greater force per pound of weight, or may even be much stronger absolutely, and consequently a vastly more valuable man in a boat crew, a tug-of-war or a foot-ball team. This was usually arbitrarily referred to his condition, and although the term was vague and without definite meaning, it yet served to express and still expresses, that combination of strength with health which makes not only athletic feats, but also the every-day labor and strain to which we are all subjected, easy, safe and even pleasant. This "condition" evidently depends upon the relation which the general strength bears to the development. A man poorly developed, with narrow chest, small limbs and meagre muscles,



who is yet capable of exerting great strength, and showing marked endurance is, unquestionably, in good condition, while the large, robust and well-developed individual, who is tired after walking a mile or feels faint after running for a street car, is in the contrary condition. Between these two extremes are a large number of varying degrees, and the first effort of the examiner is to determine in each case with as much accuracy as possible the exact "condition," as a basis for advice and for future observation. Having recorded the development he then proceeds to estimate the total available strength, and for this purpose applies a series of tests, which show the strength and capacity of the lungs, and the strength respectively of the back, legs and thighs, arms and chest, forearms and abdominal muscles. The sum of these is expressed in the same terms as those indicating the development, and can readily be compared with it, the difference between the development and the total strength indicating the "condition." If the strength is in excess of the development, the condition is good, and the figures representing it have a plus value; if the reverse is the case, the condition is poor, and the figures have a minus value.

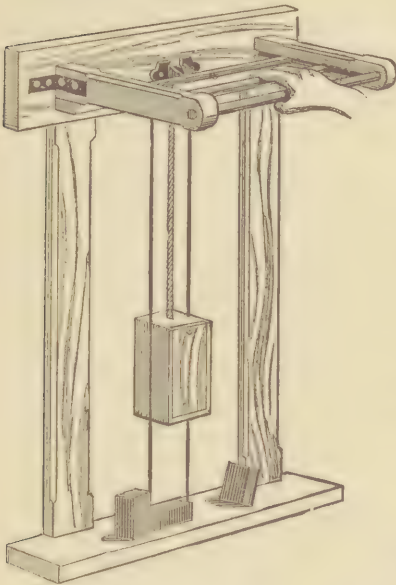
These tests of strength are made by the aid of certain machines and apparatus; they are simple, easily applied, and are not such as can of themselves be injurious. At the same time that this examination takes place the physical peculiarities are observed, and the special weakness, if any exists, is noted. The student also fills in a blank form, which serves as a record of his personal and his family history.

The examiner is now in position to give advice, if it is required, upon a number of important topics. He can point out, for example, to the man inclined to be pigeon-breasted the value of the parallel or upright bars; he can suggest to the man with weak lungs the rowing machine or the river; he can instruct the man with a feeble or irritable heart to moderate his work, or can advise him with flabby muscles, slow circulation, or undue accumulation of fat, to become more active in his exercises; he can go further than this, if need be, and can point out the proper diet to those of gouty or rheumatic parentage, the proper clothing to those inheriting a tendency to pulmonary trouble, and, in fact, can apply the general rules of hygiene or of preventive medicine to each individual case, with the advantage derived from the previous thorough and scientific inspection. It would be well, in fact, if every person in the community submitted to a similar examination, and received similar instruction. The effect of such a course in warding off preventable disease can hardly be over estimated as has already been urged on page 46.

These examinations are to be repeated from time to time, and the changes carefully noted. It has already been conclusively shown that not only are greater feats of strength accomplished when this system is properly followed, but that they are done with vastly greater ease and

safety, owing to the symmetrical development of all parts. Tables made out at Harvard, and extending over the last five years, show, for instance, taking the average of ten men as to "condition" and expressing the result in figures, that whereas in 1880 their strength was in excess of their development, as 126 to 100, in 1884 the proportion had risen to 476 to 100; or, in other words, their "condition" in 1880 being taken at 126, it had in the four years increased to 476, or nearly four-fold. The improvement may be made more readily comprehensible, perhaps, by taking a special example of physical exertion. In 1880 there was not a man among them who lifted over 393 pounds, that being the maximum. In 1884 the maximum was 675 pounds, while the minimum was 427 or thirty-five pounds more than the maximum of the first year. The concomitant improvement in health and vitality cannot be expressed in figures, but was no less marked and gratifying not only to the subjects of it, but to every friend of physical education.

FIG. 178.



The very complete and thorough system of graded exercises adapted to particular muscles by Dr. Sargent, of Cambridge, has everything to recommend it except the one item of cost. Most of the mechanical appliances are so complicated, and consequently so expensive, that they are not likely to find their way into private houses. For colleges, and even for the larger schools, however, Dr. Sargent's methods are to be strongly advised as affording the best means of carrying out the

requirements of particular developments detected in the rigid medical examination already advocated a few pages back.

As practically applied in Philadelphia with great success by that able and experienced Director, Dr. W. A. Ford, who has courteously permitted drawings to be made of the machines actually used in his admirably appointed gymnasium, the great principle of bringing into play successive groups of muscles throughout the entire human frame is most ingeniously carried out. The plan for producing a needed development in single muscles or groups of muscles which have been shown by the medical examination above mentioned to be deficient in power, that is, to fall below the average vigor (as measured by carefully observed standards) of the rest of the body, is to require of the pupil a proportionately larger number of the movements specially adapted to promote their growth.

The excellent method of further exactly graduating the intensity of this required physical exertion to the circumstances of each individual case, during the progressive improvement of successive weeks or months, is by making the force exerted in lifting weights, which may be varied from five to one hundred pounds, precisely appropriate to the pupil's need of development. Modifications of the rapidity of motion and the frequency in a given time, as, for example in one minute, with which it is repeated, are also ingeniously utilized to vary the amount of power expended and therefore of exercise secured.

The machine depicted on the preceding page (Fig. 178) is composed of a strong oak frame, from the upper part of which project two horizontal arms about breast high united in front by a firm cross bar. The inner side of each arm is grooved for a sliding frame connected behind by means of a rope passing over a pulley with a box in which suitable

FIG. 179.

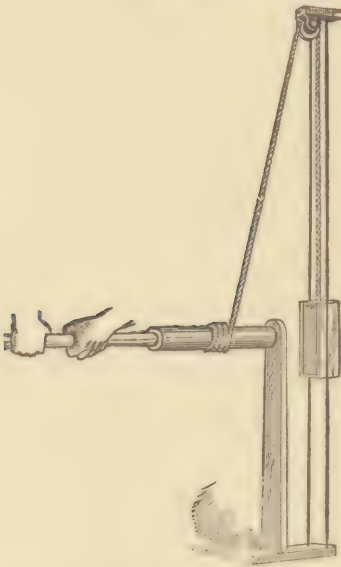
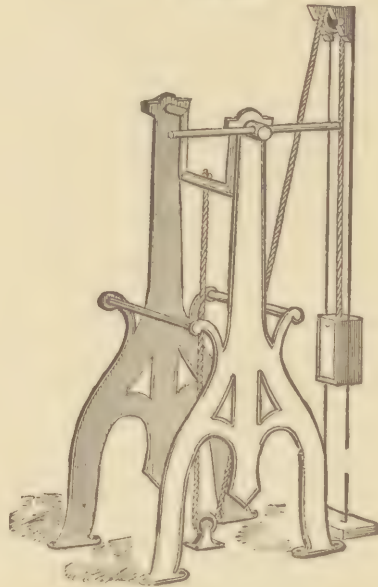


FIG. 180



weights are placed. The object of this piece of apparatus is to exercise the flexors of the forearm, and so improve the grip. In using it one or both hands are placed in the position represented in the cut, and the weight lifted by the movement of shutting the fingers, as in clenching the fist. If, as the Rev. Dr. Salzmann maintains, the ancient practice of hand-shaking was originally suggested by the wish to ascertain the wrist-power and consequent wrestling capacity of a stranger, the results of this and the next exercise would be highly satisfactory in the way of inspiring respect among a man's acquaintances.



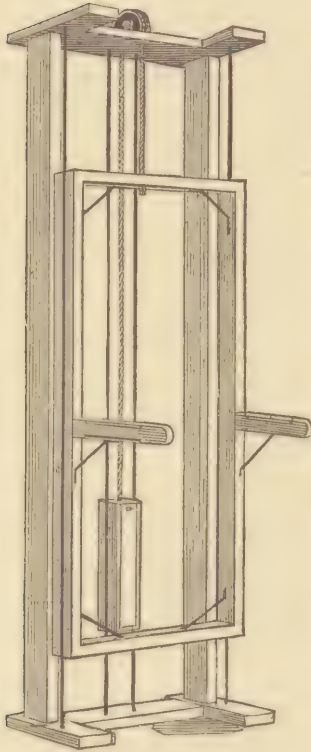
A second piece of apparatus for strengthening the wrists and invigorating the muscles of the forearm primarily, and of the arm proper and shoulder secondarily, is the windlass shown in Fig. 179. A smooth, round wooden bar about an inch and a half in diameter is so arranged upon supports as to revolve readily. By coiling a rope around a thicker portion as it rotates, it raises a box which slides upon guiding rods and contains iron weights sufficient to produce a due amount of fatigue in the forearm muscles of the learner. Not only may the number of pounds thus lifted be advantageously varied in accordance with the requirements of a particular case, but the rapidity with which the bar is turned, and the number of times the rope is wound up without pausing to rest, may be almost infinitely combined. And these combinations can be arranged so as to render the muscular effort more or less exhausting, thus accomplishing the greatest amount of good in the shortest possible time for individuals of widely differing physical development. The exercises upon this appliance may be beneficially varied by having the pupil turn the roller first from him with the palms of both hands downward, then with one hand palm upward and the other palm downward, then with the backs of both hands downward. The same positions being assumed the learner should rotate the top of the bar towards him, in order to bring a slightly different group of muscles into play on each occasion. The weights used may vary from five to twenty-five pounds, the number of repetitions from ten to forty times, and the rate per minute also from ten to forty, the latter frequency requiring, of course, very rapid movements.

The next exercise is especially intended to develop the upper arms, the shoulders and the large muscles on the front of the chest, and is therefore particularly valuable for those who have inherited or acquired any tendency to consumption or other pulmonary disease. It consists of a stout frame having sockets near the top for a metallic axle bent, as shown in Fig. 180, and operated by a cross bar in such a way as to lift the weight supported by a rope passing over two pulleys. Here, on account of the length of the short arm of the lever in this modification of the third mechanical power, the pupil's own strength operates at a great disadvantage and rest for a few minutes in a reclining posture before commencing any other exercise is in many cases advisable after its employment. In using the machine the cross bar should be seized by its extremities and the arms being held straight and the body leaning backward the rod should be slowly rotated over a semicircle, first in one direction and then in the other. After some practice the hold may be shifted to points about six inches from the ends of the rod, and the same movements repeated with the disadvantage of a greatly diminished leverage on the side of the operator. The weights in the box may vary from twenty to sixty pounds and the semi-revolutions of the axle may be repeated as often as a hundred

times in two minutes without stopping to rest, after skill and strength have been acquired by practice.

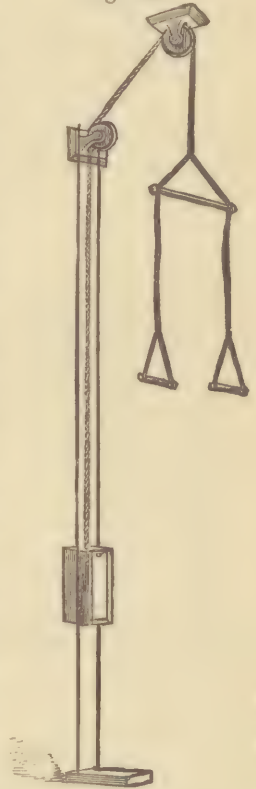
The fourth machine (Fig. 181) is designed to promote the development not only of the arms and shoulders, but also of the front of the chest and of the upper portion of the back. The pupil should place himself between the projecting bars with his face turned away from the machine, and seizing the handles slightly in front of the body push them, and, of course, the entire frame work to which they are attached, down until

Fig. 181.



the arms are stretched to their full length. As soon as the pressure is relaxed the weight in the box causes the frame to rise again, and so the downward movement may be repeated as often as desired. The head should be held erect during the whole movement, and the shoulders being thrown back whilst the lungs are distended with air, by drawing a deep breath just before extending the arms downward in an energetic manner, the due expansion and invigoration of the lungs will also be actively promoted. An advantageous variation of the evolutions with this appliance is to take

Fig. 182.



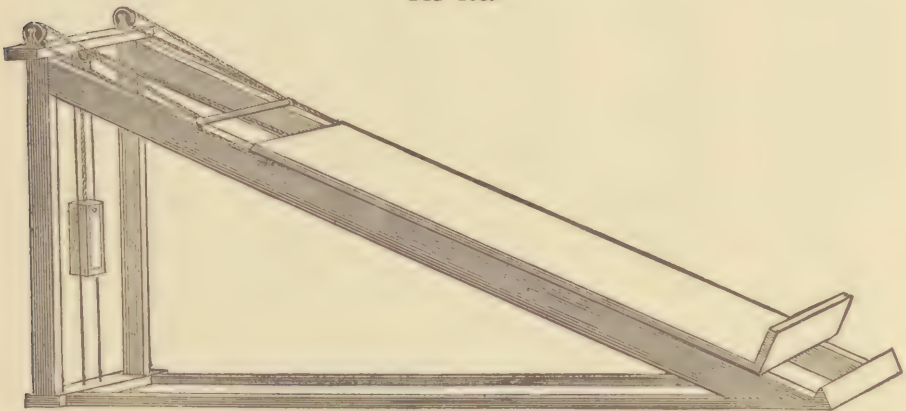
a position facing the machine and push down the horizontal handles, lifting part of the weight of the body upon them, and thus preparing the learner for exercises upon the parallel bars, as described further on in this chapter.

The next machine (Fig. 182) is used to develop the broad muscles on the front of the chest which are largely instrumental in the vigorous and healthful performance of the function of respiration. The learner should take up his position some four feet in front of the apparatus, and grasping the handles step forward with the left foot and at the same time bring the handles forward from the line of the body, and extend the arms

until they are nearly straight. The head should be carried erect and the chest well forward. The movements with this appliance may be variously modified in ways which will readily suggest themselves, so as to operate very favorably in promoting the development of the chest and upper part of the thorax in general. For example, by standing with the face to the apparatus the handles may be pulled down as far as the knees, bending the legs at each movement. Or again, taking a position with the face turned away from the machine the handles may be seized over the head and the body being inclined forward whilst the arms are retained in an extended posture the pupil should make the hands describe semicircles to the lowest point, and then flexing the arms and again standing erect resume the original position.

A contrivance for enabling the scholar to put forth the strength of his arms whilst the remainder of his body is at rest in the reclining posture is shown in Fig. 183. The platform furnished with a footboard, and slid-

FIG. 183.



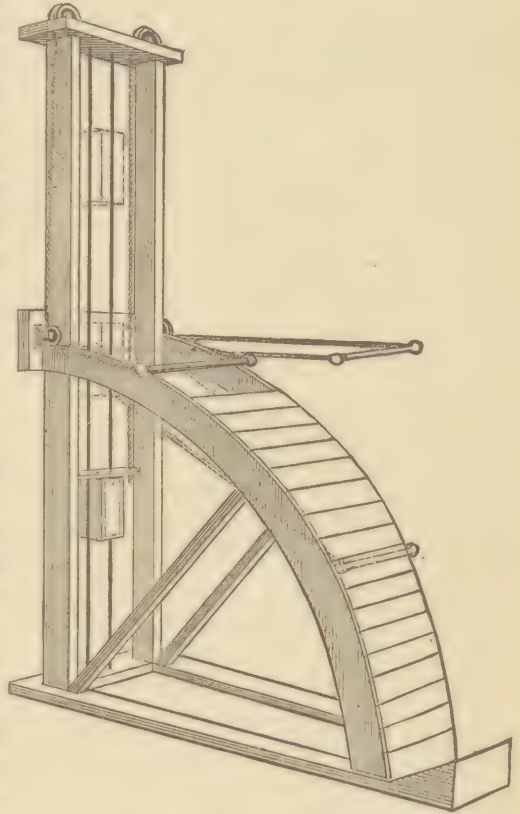
ing easily upon the inclined plane, forms a support for the learner's body, which constitutes the chief weight to be lifted. The elevation of this weight is accomplished by the muscular strength of the arms and shoulders acting by means of a cross bar and ropes passing over pullies and attached to the upper end of the sliding platform. For beginners the weight of the platform and resistance from friction may be more or less counterpoised by the addition of weights in the box represented at the back of the figure. The varying amounts of muscular exertion found advisable are procured by bringing the bar grasped in the hands, placed either near together or a foot apart, down as far as the breast, the hips, the middle of the thighs, or the toes. In the latter variation the body must, of course, assume a sitting posture. Additional modifications which are highly recommended result from pushing the extended arms upward and forward, so as to describe a semicircle from above the head to the middle



of the hips, also by drawing the bar half way down some six or eight times whilst the breath is held and the lungs fully inflated.

The imposing looking appliance figured below is especially valuable for developing the broad flat muscles of the chest and abdomen, and also aids in invigorating the arms, shoulders and spine. The pupil is instructed to lie back upon the curved platform, and seizing the cross bar joining the ends of the two ropes over the head lift the weights by drawing down the bar in a diagonal, or out in a horizontal direction, sometimes causing the hands to describe a semicircle of which the shoulder-joint is the centre.

FIG. 184.



The chest weights (Fig. 185), of which there should be a large variety adapted to pupils of different height and strength, are highly advantageous for developing the muscles of the thorax, including, of course, many of those concerned in the vital process of respiration. They are usually arranged in pairs, as exhibited in the marginal illustration, and the boxes are loaded with weights amounting to from one to fifteen pounds. The beginner is advised to take a position facing the apparatus and far enough distant to hold the weights elevated half an inch or so when the arms are fully extended. Then draw the handles first one and then the other directly backward until they almost touch the shoulder, repeating this movement ten or fifteen times in the space of half a minute. The next motion may be to carry the handles downwards and backwards until they go a little beyond the learner's thighs, the alternation of movements being kept up as before. A third variety of motion is turning the back to the apparatus, to shoot out the hands with the handles grasped in them straight forward from the shoulder as in boxing, keeping the legs and back rigid, and the lungs well inflated with air. The downward diagonal motion of the hands should also be practiced in this position. Another variation is to turn the right side towards the machine, and resting the

right hand on the hip, bring down the left hand holding the handle close to the side. After from five to twenty motions of this kind give the right arm in turn its share of exercise, and modify this again by pushing the hand out horizontally as far as one can reach, and subsequently carrying it diagonally upward to its utmost limit in that direction. Finally resume the original position with the face towards the apparatus, bringing the

hands up and over the shoulders in a graceful curve. A second course, made up of more complex movements with the chest weights, is to be highly recommended for more advanced students.

In order to correct the vicious habit of stooping acquired by so many scholars by bending over their books, the ingenious contrivance depicted in Fig. 186 has been devised. It consists of a chest weight modified by having instead of a handle a sort of cap, intended to fit over the back of the pupil's head. When used the weight is to be drawn up by backward

movements of the head, accomplished by energetic contractions of the muscles of the neck and spine, which are thus stimulated to increased growth. Used in conjunction with the improved desks, seats, and so forth, already recommended on page 461 in the article on school hygiene, this piece of apparatus is highly beneficial in overcoming the tendency to assume a stooping posture, so common among students, both children and older persons. It is therefore especially to be recommended for people who have inherited any predisposition to consumption, because the imperfect development of the apices or tops of the lungs, almost mechanically caused by this stooping position, seems particularly apt to promote consumption. It is found by pathologists that when people die of consumption more than two-thirds of the cases, show the greatest amount of tubercular deposit at the top of the lungs, just beneath the collar bones, where due expansion of the air-vesicles is most seriously interfered with by sitting in a stooping posture. And this stooping position is especially the result of weakness of the muscles at the back of the neck and upper part of the spine, which are chiefly strengthened by a judicious use of the machine now under consideration.

Another complicated piece of apparatus, which brings into play a large number of the muscles both in the upper and in the lower limbs, is that

FIG. 185.

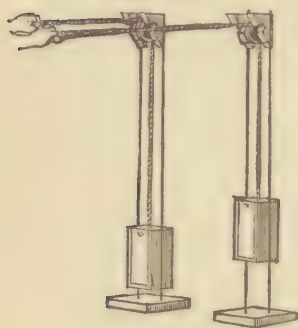
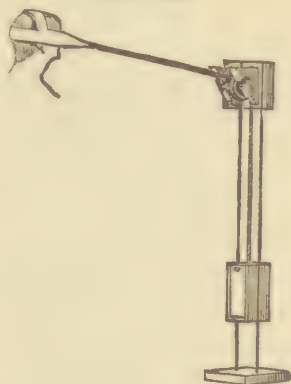


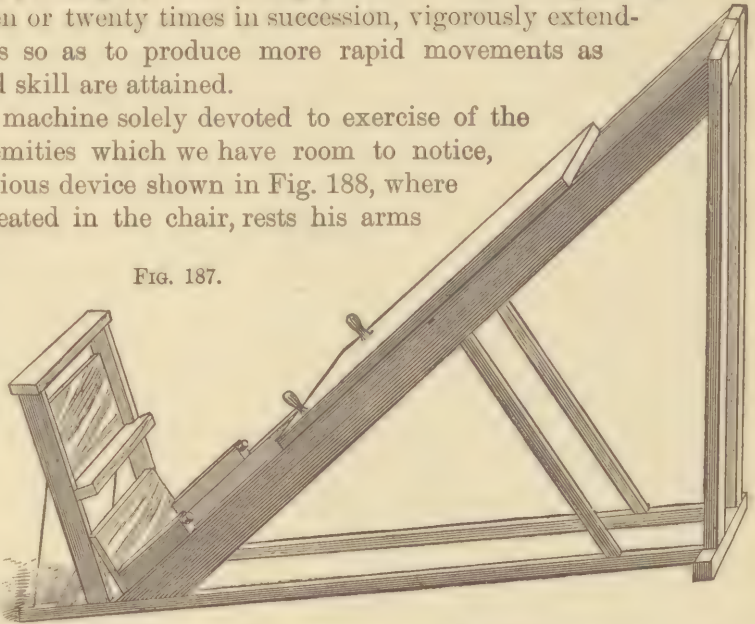
FIG. 186.



depicted in the next illustration. It is so arranged that the weight of the pupil's body gives the chief resistance to be encountered, as the learner reclines on his back upon the broad board furnished with handles which slides upon the inclined plane. One method of using it is to place the feet on the foot-rest in a line with the platform, and then pushing the board down until the handle can be seized, straighten out the legs, at the same time throwing the weight of the body upon the shoulders by lifting the hips clear of all support. The groups of muscles brought into play may be somewhat varied by placing the feet higher up on the shelf above the foot-rest, pushing up the sliding platform and letting it slip back five, ten or twenty times in succession, vigorously extending the legs so as to produce more rapid movements as strength and skill are attained.

The only machine solely devoted to exercise of the lower extremities which we have room to notice, is the ingenious device shown in Fig. 188, where the pupil, seated in the chair, rests his arms upon its arms and grasps the extremities firmly. The feet are then placed on the treadles, which are so connected by

FIG. 187.



ropes passing over pullies behind and above the chair, that extending the legs lifts the weight-boxes which are loaded to any desirable extent. Exercise in this apparatus may be varied by pushing out the feet alternately or together, or by making the leg extensions on each side in groups of two, three or four, as happens to be preferred. Still another modification is afforded by sliding down in the chair until the back rests upon the seat, and then kicking out first with one foot and then with the other, letting the knees on the recoil come almost up to the chest as the pupil lies in his supine position.

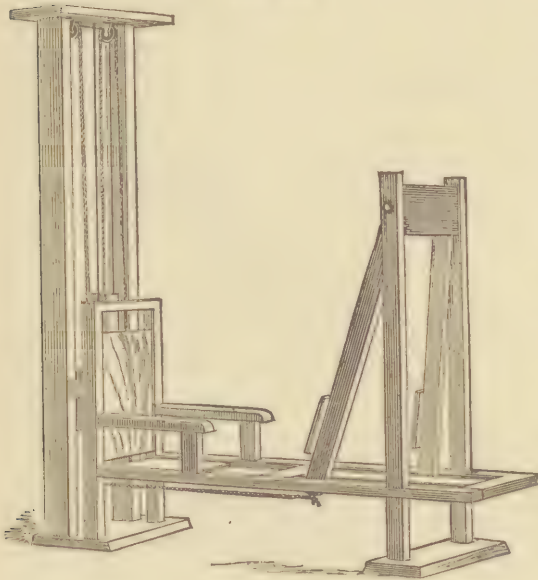
Whilst, as before remarked, few private houses will ever be supplied with complete sets of Dr. Sargent's costly and complicated apparatus, it would be well for every person who can afford it to procure the two or three of these machines, which are the ones especially adapted to his particular needs in the way of exercise. For example, a young man who comes of a consumptive family might diminish his hereditary tendency, and even



ward off a threatened attack of the disease, by systematic daily practice with the chest weights and the contrivance represented in Fig. 182. Or a young girl who has contracted the injurious and awkward habit of stooping, might so invigorate the muscles of the back of the neck by proper employment of the modified chest weight fitted with a cap, as depicted in Fig. 186, as to acquire an erect and graceful carriage.

Many ingenious individuals among our readers can no doubt readily contrive simple and inexpensive ways of putting into operation the invaluable principles upon which these intricate machines are constructed.

FIG. 188.



A couple of small pulleys furnished with screws, such as can be bought at almost any hardware store for fifty cents, may be fitted in the jambs of a door with very little trouble. Then two pieces of clothes line, each tied at its upper end to the middle of a piece of wood for a handle, and after being run through the pulley fastened to an iron or leaden weight, a couple of bricks, or a basket filled with stones, will form a pair of chest weights, which, though not so ornamental, are quite as useful as handsomely fitted appliances

purchased at twenty times the cost. In fact, the satisfaction some people feel in constructing and using home-made apparatus, which answers every purpose of a high-priced article, will occasionally contribute to a more persevering employment, and therefore a more lasting benefit from the muscular exercise it demands.

The use of strong rubber bands or tubes instead of weights, to afford the resistance required in these various contrivances, has some advantages on account of their occupying less bulk and being far more easy of transportation. The augmented resisting power necessary as pupils acquire strength and skill by practice, can easily be added by increasing the number of bands, or employing thicker rubber strips or tubing, as may be preferred. Modifications of the rubber band principle are introduced into several of the various forms of portable apparatus for physical exercise which are so largely advertised. The value of these contrivances, usually but a small fraction of that claimed for them by

their inventors, may be very fairly estimated by any attentive reader of the present and the preceding chapter in this volume, from the general principles enunciated and the particular appliances described.

### The Vaulting Bar.

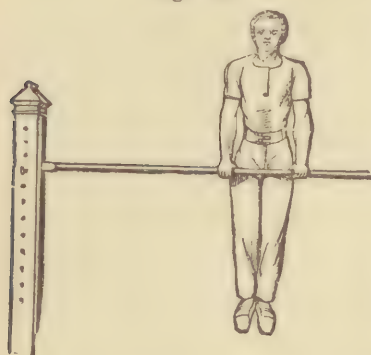
Among the forms of apparatus designed to promote the development of the lower limbs, the vaulting bar and vaulting horse are worthy of especial attention. The bar should be made of ash, specially selected for its freedom from knots and for its straightness, turned perfectly round, two and a quarter inches in diameter, except at the ends, where square shoulders or tenons should be formed, to run up and down the grooves, or space between the standards. The standards ought to be seven feet high, and be placed seven feet apart, made of two upright pieces united with a space of one inch and a quarter between them, to receive the shoulders at the ends of the bar, and pierced with holes three inches apart, fitted with movable wrought-iron pins, for the bar to rest on. When it is desired to have the bar of less diameter, it should be bored throughout its whole length, and a well-tempered steel rod or core inserted. This rod ought to terminate at each end in a brass cap fitting the shoulder of the bar.

A bar of this kind, which can be elevated or depressed to suit the capacity of the pupil, and the diameter of which is small enough to admit of its being grasped by the hand, is the simplest form of the vaulting machine. In using such an appliance the primary movement is very similar to that of leaping, as hereafter described, except that as the hands grasp the barrier the upper limbs take up and supplement the effort after the lower extremities have completed the spring. In the first form of vaulting the body is carried over the barrier in a horizontal line, being from head to foot when above the horizontal pole, exactly parallel with the bar itself. In the second variety the lower half of the body is lifted by the action of the loins, elevated above the hands as they rest upon the bar, and thrown straight to the front. A third form combines in some degree both of these, and in it the body is thrown from its vertical position above the bar, to the right or left front, according to the side on which the vault is made. All these varieties of vaulting require special care on the part of the instructor, who should impress upon the pupil at every opportunity the necessity of keeping the lower limbs close together and in proper position. The position of the teacher should be in front of the pupil, with one hand grasping the wrist nearest to him, and the other hand held in readiness to give assistance if required.

In the first exercise, raise the hands to grasp the bar, they being placed as far apart as the width of the body at the hip. Lift the feet from the ground, pressing strongly with the hands, rising to the full extension of the arms, and inclining the body slightly forward during its ascent. The head should be held erect, the spinal column upright, the legs straight

and close together, the feet together, and the toes pointing to the ground. After assuming the posture described (Fig. 189), raise the left leg, still keeping it stretched out to a right angle with the other limb, thus permitting the

Fig. 189.



foot to be placed upon the bar, the hollow of the foot resting on its upper surface, as represented in Fig. 190. Lastly, raise the right leg and bring the right foot up to the left, clear the bar, the whole column of the body and the lower limbs passing over it in a horizontal line, as shown in Fig. 191. Hold the arms well bent, and after crossing the bar loosen the grasp and descend with the face toward the bar opposite the part grasped by the hands. This exercise should be repeated on the right

side, so as to bring the corresponding muscles of that half of the body fully into play.

In a second exercise, called vaulting over the bar by the back-lift, the bar is grasped as above directed, and then, putting forth a vigorous effort, with both hands and feet simultaneously, throw the body over the bar in a straight line vertically above the head, the arms bending during its

FIG. 190.

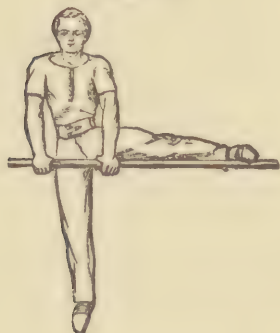


FIG. 191.

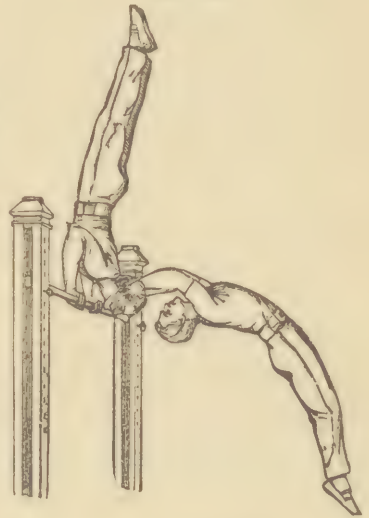


ascent, the elbows held close in by the sides, the head and shoulders inclined to the front, the column of the body and the lower limbs, with the toes pointed upward, making a vertical line when above the bar, as represented by the figure on page 941. From the point of highest elevation throw the feet to the front, bending the back inwards, and raising the head as the feet approach the ground, loosening the grasp and descending with the back to the bar. This exercise may be rendered more difficult by swinging on the bar once or twice before commencing the somersault which is to be completed as above described.



To vault the bar over one hand, the earlier steps of the process are the same as in the last exercise; but during the elevation of the lower limbs above the bar, instead of retaining the body between the hands, incline it over the right arm, the trunk and lower limbs revolving toward the right. The elevation of the lower limbs is then to be completed until they rise straight above the bar over the point grasped by the right hand, quit the grasp of the left, and pass it over the head, descending the right side next to the bar, the grasp of that hand loosening as you come down. To vault the bar with one hand, grasp the bar strongly with the left, slightly bend the lower limbs, and on their return extension, spring from the ground, incline the body forcibly over the right arm, rapidly elevate the left hand above the head, and throw the lower limbs straight and together over the bar, loosen the grasp, and descend facing the bar.

FIG. 192.



### The Vaulting Horse.

This is a machine of a much higher order than the bar, presenting a far wider range of exercises, second to none in value and number. In the cavalry drill of soldiers it plays a very important part, and at West Point and other military schools systematic training upon this piece of apparatus is rigidly enforced. The body of the vaulting horse should be perfectly smooth, the top and sides covered with leather, the upper portion being stuffed with horse-hair. The pommels should be movable and the legs provided with slides, so that the horse can be set firmly at any height between three and six feet. Great care must be taken to avoid falls, consequent upon the hand slipping from the surface of the leather during the elevation of the lower limbs. Nothing causes a fall so readily as the fear of falling. The three series into which the exercises divide themselves are very distinctly marked, and admit of progressive practice long after the correct action and position have been attained, by increasing the elevation of the machine.

These exercises can hardly be too often executed, as they give widely varied and valuable employment to both upper and lower limbs, and also to the trunk. This machine is always found to be an excellent one to begin the lesson, because it affords much and rapid movement without severe or localized effort. The first series is obviously an introduction to the second. The third set is very artistic and effective, and cultivates to the highest attainable point that precision and security of grasp and

spring, which are especially valuable to every horseman, and useful in all exercises when practically applied.

The position of the instructor should be close to the machine, in front of the learner, directing every motion, and, in the early stages of his practice, counting the time of his movements and pointing out to him the features of the position in the ascent, rest, and descent. The teacher

FIG. 193.

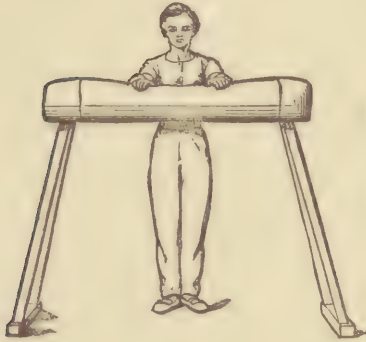
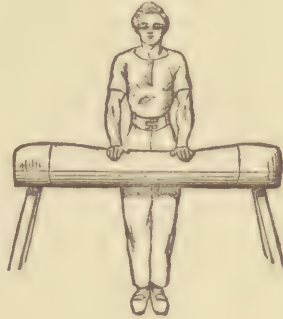


FIG. 194.



ought also to repeatedly execute the exercise himself, in the manner most likely to make the learner comprehend its peculiarities. At the same time he should encourage the pupil, if timid or hesitating, and lose no opportunity of obtaining his entire confidence in every situation, however

FIG. 195.



critical. If the vaulting horses are not adjustable, as recommended above, there should be two or three of them; having in the latter case, the respective heights of four feet, five feet, and five feet six inches.

In the primary series—that of the standing exercises—the first is vaulting on the horse in two movements. Standing beside the apparatus, place the hands upon the back of the horse at a distance equal to the width of the hips, the thumb and fingers straight and together, and pointed toward the front (Fig. 193). Bend the legs and spring upward from the ground, inclining the body to the front, press forcibly with the hands, extend the arms, and raise the entire body above the horse, the legs held straight and close together and the feet pointing toward the ground, as in Fig. 194. Secondly, elevate the right leg, and by a continuous movement bring it over the back of the horse, the column of the body turning with it, and, as the right thigh approaches the right hand, advance the latter until it comes in a line with the left hand, and

slowly lower the body to the saddle, bringing the head erect and the chest well advanced. The hands at the conclusion of the operation rest lightly on the thighs, with the lower limbs pendent and the toes pointed toward the front (Fig. 195). In dismounting, incline the head and trunk of the body toward the front, raise the left leg to the rear until it clears the back of the horse, the right rising to meet it, support the weight on the hands, and descend gradually, facing the horse.

This exercise, like all the others, should be repeated with the left leg taking the initiative, in order to invigorate the muscles on the opposite side of the body to an equal extent. To vault on the horse in one movement, the motions are the same; but instead of a pause for rest, they are made continuously until the seat is attained.

To vault over the horse in two movements, spring up against the horse as in the first positions of the previous exercise. Then elevate both limbs to the right, pass them over the horse, incline the head and shoulders forward, advancing the right hand to

a level with the left, support the body on both hands, and descend on the other side gradually, turning round so as to face the horse. As usual, this exercise should be repeated, passing toward the left. Vaulting over the horse in one movement is ac-

Fig. 196.



complished by simply making these separate efforts continuous, and should be practiced first on one side and then on the other, alternately. To vault the horse resting on the knees, place the hands on the back of the horse as in the first exercise, spring from the ground as before, incline the head and shoulders forward, extend the arms, and bring the knees straight up between them, resting on the saddle. In dismounting, rapidly throw the hands forward as high as the face, spring from the rest with the lower limbs, and come down on the feet. In vaulting the horse resting on the feet instead of resting on the knees, bring the latter up as high as the breast, between the arms, and place the feet on the saddle. Then immediately straighten the legs and assume the erect posture. To vault over the horse between the hands, the movements are almost exactly identical with those of the exercise next but one preceding, except that the feet, instead of resting on the saddle, should be shot through the space between the hands.

In vaulting on the horse with one hand, you take the usual position, facing the side of the machine, and raise the left hand, placing it on the horse, the other arm being extended to the rear. Next bend the legs slightly, and with a spring elevate the right leg and pass it over the horse, at the same time rapidly raising the right arm above the head, the hand closed, and come to the seat in the saddle. In dismounting, incline



the head and shoulders to the front, support the weight with the left hand, and descend as before directed. To vault over the horse with one hand, modify the above by throwing both legs, held straight and well together, over the horse, coming down facing the machine on the other side.

To vault over the horse with a running jump, take a position some twenty-five feet from the apparatus. Slowly begin the run, quickening the pace as you advance.

FIG. 197.



When within two or three feet of the horse, spring from both feet, striking them full and flat upon the ground, placing the hands on the horse immediately after the spring. The body and limbs should be held in such a position as to form a nearly horizontal line as they pass over the horse, and the right hand ought to be

slipped along until opposite the left, supporting the body in a gradually yielding descent. (Fig. 196.)

Vaulting over the horse by the back lift or turning a somersault (Fig. 197) is to be done by the aid of a running jump—as is described in the last exercise. Place the hands on the back of the horse, depress the head and shoulders until the latter are as low as the hands, and at the same time elevate the lower limbs, hips and loins until they rise perpendicularly

FIG. 199.



over the hands, the legs straight and held well together, and the toes pointing directly upward. Continue the curve with the lower limbs, bending the spine inwards, and alight on the feet as shown in Fig. 198.

FIG. 198.

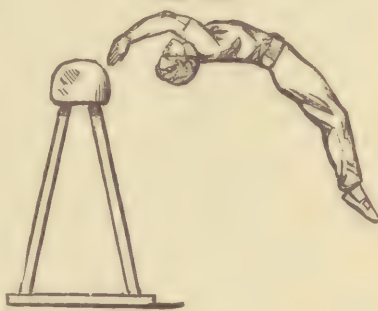
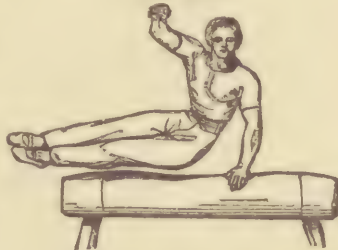


FIG. 200.



To mount the horse on the croup, commence with a running jump, spring with both feet, place the hands on the croup of the horse in a line transversely. Fully separate the lower limbs and as the body reaches the croup slip the hands along the horse so as to leave room for taking an easy seat, in the required position as shown in the illustration (Fig. 199).

Vaulting over the horse with one hand (Fig. 200) is also done with the aid of a run of twenty-five or thirty feet, the spring being made two and a

half feet from the horse. The left hand is placed upon the horse's back, the right arm thrown above the head, and the legs swung lightly in a horizontal position over, leaning forward after clearing it and descending gently so as to stand on the left side of the horse at the conclusion of the leap.

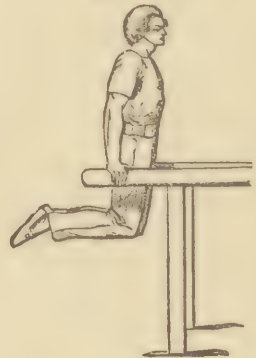
### The Parallel Bars.

All these movements are performed between the bars, and bring into play chiefly the muscles of the trunk and arms, especially the former. They may be divided into three series, of which the first consists of travelling along the bars forward or backward, single or double-handed. The second set comprises movements of oscillation between the bars, and is a most valuable and attractive series, giving a great variety and complexity of exercise to all the muscles of the trunk and upper limbs. The third set is made up by combinations of the other two. For beginners

FIG. 201.



FIG. 202.



the prescribed directions may be departed from a little; some aid derived from movements of the limbs, and without rigidly adhering to the rule that the legs should be kept in close juxtaposition. After a certain amount of skill, however, has been acquired by practice, these exercises become great favorites, being in themselves varied, pleasurable, and capable of fine artistic effect, beside leading to the acquisition of much muscular power and dexterity of action in both trunk and limb.

The parallel bars should be from eight to ten feet long, twenty inches apart inside, and firmly fixed at a height of three feet eight inches from the floor. The upper surface ought to be carefully smoothed and rounded to fit the hands.

The first exercise, called the single march forward, is commenced in the posture represented in Fig. 201 above. Raise the hands and place them on the bars, the thumbs inside and the fingers outside pointed downwards and fully extended. Press downward with the hands until

the arms are fully extended, and the body lifted to the highest point. Hold the head erect, the eyes directed toward the front, the chest advanced, the shoulders square to the line of the bars, the column of the body upright and firm, the lower limbs straight and together, the feet together

FIG. 203.



and the toes pointed to the ground. The mode of progression is by resting on either hand alternately, and moving the other along the bar six inches, until by these short hand-steps the whole length of the machine is traversed. The single march backwards is performed by reversing the movements, all the regulations in regard to attitude being carefully observed. In the double march backward and forward the position is the same as in the preceding

ing exercises, except that the lower limbs are bent at the knee nearly to a right angle (Fig. 202), and the toes pointed toward the rear. Then, without altering the relative positions of the body and limbs, spring forward the distance of the step in the single march. Repeat this until the ends of the bars are reached, and then reverse the movement.

To clear the bar by the front, take the position of the single march forward near the middle of the apparatus, and then quietly elevate the lower limbs, the toes pointed towards the front, until they rise above the level of the bars, and then pass them over the right bar as shown in Fig. 203. When clearly over it, relax the extension of the legs, transfer the weight of the body to the right hand, pressing strongly with the left, and spring to the ground. This movement should be repeated over the

FIG. 204



other bar in order to equalize the development of both lateral halves of the body, a balance which should be systematically maintained. It may also be modified so as to clear the bar by the rear raising the limbs to the front first, and as they swing back elevating them until they rise above the top of the bars and passing them over the left one. At this stage of the exercise the arms bent at the elbows support the head, trunk and lower limbs, in a nearly horizontal line just above and parallel to the bars. In descending, press strongly with the right hand, and spring to



the ground facing the apparatus. A complicated movement, called by Maclaren resting on both bars in front and clearing the right one by the rear, is thus described: First assume a sitting posture on the bars as shown in Fig. 204, then elevate the legs and let them swing between the bars to the rear, at the same time bending the arms and shoulders as low as the bars, and bringing the column of the body with the lower limbs to a horizontal line. Lastly, swing the legs and loins sidewise so as to clear the bar and descend lightly to the ground, with the face toward the machine. As usual, this exercise is always to be repeated, clearing the other bar in order to secure an equilibrium of development.

A vast number of modifications and extensions of these exercises upon the parallel bars might be detailed, but enough has doubtless been written to indicate the wide field of usefulness covered by this valuable gymnastic appliance.

### The Trapeze.

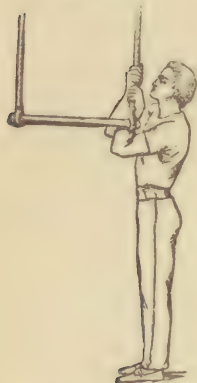
In importance this machine ranks with the parallel bars, not so much because of the number of its exercises, as on account of their artistic character, and the power which they possess of testing and increasing the capacity of the trunk and upper limbs. Every exercise on this machine consists of one or more evolutions of less or greater difficulty, of which the hand-grasp on the rope, or the bar, or on both, forms the centre, the entire weight of the body and force of the movement being sustained by it. In the exercise of the first series on this appliance the ropes are grasped with either one or both hands, whilst in the second the ropes are carefully avoided, and the hands are clasped upon the bar alone.

All these exercises may be practiced by beginners, the form of each as given in the text being the perfect one; but some modifications may be introduced for initiating practice. Thus a beginner in the first exercise, instead of grasping the rope only a hand's breadth above the bar, may seize it a foot or more higher, the left hand following close under the right, and then day by day as the difficulties of inexperience are surmounted, the space between the hands and the bar may be reduced, until the position directed in the text is finally assumed. The exercises of the second series are all arduous, but also permit of gradual approach. For instance, in the first a slight spring may be taken, and both arms and legs allowed to remain bent: after a few days practice the spring may be dispensed with; next the legs may remain bent at the commencement and be extended during the rise; lastly, keep the legs straight and the arms bent as advised in the perfect exercise. The best grasp for the instructor, if one is present, in directing the evolutions on the trapeze, is a firm hold of the wrist with the left hand, whilst his right securely grasps the leg of the pupil's trowsers at the ankle. He ought to stand on the right or left of the apparatus facing the learner.

The bar of the trapeze should be two feet six inches long, and one inch and a half in diameter. It should be suspended by its ropes at a height of four feet and a half from the floor.

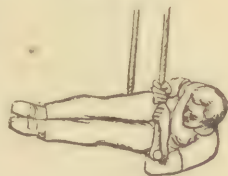
In the first exercise the pupil learns to rise by the single rope in the following manner: Standing at the side of the apparatus, elevate the right hand and grasp the rope a hand's breadth above the bar, the left

FIG. 205.



hand following in the interspace (Fig. 205.) Lift both feet from the ground, holding the legs well together, the toes pointed to the front, and passing them over the bar elevate the body until the hip rests on its surface (Fig. 206). Then

FIG. 206.



press downward with the hands, and rise seated on the bar retaining the grasp of the rope Fig. 207. In descending lean slowly back-

ward and sidewise, bringing the hip again on the bar, remove the limbs from it, and, reversing each movement in turn,

return to the first position. This exercise, like the others which follow it, should be repeated with the other

side of the body correspondingly brought into play. In this instance the left hand ought to be placed uppermost, the pupil standing on the left side of the apparatus.

To rise by both ropes take a position facing the trapeze, raise the hands and grasp the ropes, one in each hand close to the bar. Lift both feet from the ground and pass them under the bar between the hands, at the same time allowing the head and shoulders to fall back-

FIG. 207.



ward and straightening the arms. Then

by a continuous movement bend the back

inward and extend the lower limbs

upward, flexing the arms so as to draw

the hips up as high as the bar (Fig. 208).

Slowly let the feet descend to the front, and

at the same time and at the same rate let the

trunk, shoulders and head ascend and

come to a seat on the bar retaining the

grasp. During the last movement let the

chin be elevated, the shoulders pressed back and the breast advanced square to the front. In descending, lower the

body from the bar backwards, let the limbs fall to the rear, repass the feet under the bar between the arms, and come back to the first position.

To rise by the back-lift, grasp the rope with the right hand, and the middle of the bar with the left. Lift both feet from the ground by the flexion of the right arm and extension of the left, and rise until the face

FIG. 208.



is as high as the right hand, the left arm being held straight and perpendicular over the hand grasping the bar. Turn to the right without moving either hand, and take the seat on the right hand half of the bar. Rising by the front lift is accomplished by assuming the position with the face as high as the right hand described above, and instead of sitting down on the bar lifting both feet and passing them through the space between the left hand and the right rope to take the seat. To turn around the ropes right and left, come to a seat on the bar as directed in the fourth of these exercises. Then raise the left hand and grasp the right rope as high as the face, slip the right hand down to the bar and seize hold of it close to the rope, the thumb to the front and the fingers to the rear. Lift the body from the bar, turn around the outside of the right rope, the

FIG. 209.



FIG. 210.



FIG. 211.



feet leading, pass the lower limbs between the ropes and come to a seat on the bar. Lastly repeat the same maneuver around the left rope, reversing, of course, the respective positions of the hands.

To turn around the bar forwards, take a position as in the second exercise, grasp the bar with the hands at a distance apart equal to the width of the body at the hips, the backs of the hands being upward, and the fingers and thumbs meeting. Bend the legs forwards, at the same time lowering the body until the arms are fully extended, keeping the legs together and straight, the feet together and the toes pointed toward the front, as shown in Fig. 209. Next lift the feet upwards, the arms remaining straight until the feet are as high as the bar (Fig. 210). Bend the arms and at the same time elevate the body until the waist is on a level with bar, over which the lower limbs are to be passed, the trunk following and revolving on the waist. Lastly, lower the body completing the circle, and slowly descend until the feet meet the ground. To turn round the bar backwards assume the position shown in the second of the above wood-cuts, and then instead of raising the legs over the bar, pass them



underneath it, and by a continuous movement bend the back inwards, and extend the lower limbs upwards, flexing the arms so as to lift the waist as high as the bar. Allow the lower limbs slowly to fall to the front, and as they descend let the upper half of the body ascend in position, the head well thrown backward, and sink slowly down the spine held in contact with the bar until the feet touch the ground.

Many other exercises, either simple or combined, of great interest and value have been devised in connection with this apparatus, for a detailed description of which the reader is referred to Maclaren's admirable work on physical education.

### The Rings.

The rings combined, as they usually are, give a varied course of movements, somewhat similar in character to those of the trapeze, and especially useful in developing the upper part of the trunk and the arms. In

FIG. 212.



FIG. 213.

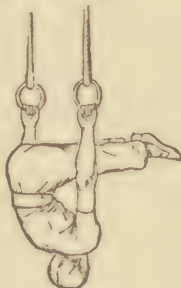


FIG. 214.



this way they are exceedingly valuable as supplementary to a due amount of culture in the lower half of the body gained in running and walking. The rings should each be five inches in diameter, suspended at five feet six inches from the floor, and about eighteen inches apart.

In the first exercise the pupil standing between the rings raises his arms, and grasps the rings one in each hand, then lowers his body until the arms are fully extended, at the same time passing the feet forward, the legs held together and straight, the toes together and pointing towards the front, as shown in Fig. 212. Then throw both feet upward, and turning a somersault, pass them between the rings, the arms and legs being held straight throughout, slowly descend to the ground completing the circle and relinquish the grasp. A modification of this, called the double circle, is performed by returning to the first position, instead of quitting the hold on the rings, when the last posture depicted above has been assumed.

To turn with the feet in the rings proceed as above directed until the feet come between the rings, but then instead of continuing the somersault separate the feet right and left, and insert each into its respective ring. Continue with the trunk of the body the movement in a circle, slowly separating the knees, lowering and arching the back and raising the head. Lastly reëlevate the trunk to its position in the half circle, remove the feet from the rings, straighten the legs, point the toes upward and let the limbs gradually descend to the front until the first position is regained.

To turn on one hand right and left, make the complete somersault as in the first exercise, but at its conclusion instead of relinquishing the grasp with both hands retain the hold with the right, passing the left arm down at the side, and folding the lower limbs under the body, as shown in Fig. 214. Make a complete turn laterally from left to right, seize the ring again with the left hand, and extend the lower limbs to the front as in the primary position. Lastly, repass the feet between the rings, make an entire turn from right to left, retaining the grasp of the left hand, seize the ring again with the right, extend the lower limbs to the front, and come back to the original posture.

To extend the arms left and right assume the first position, and then bending the arms so as to raise the shoulders to the rings, sustain the body on the left hand, retaining it close by the side, extend the right arm holding the ring at its full length, pause a moment and return the right arm to the side. Lastly, repeat this entire movement with the left arm, lower the body and come back to the original position.

In order to rise above the rings assume the same position as in the first exercise, bend the arms until the hands are level with the rings, raising the lower limbs into position. Next press strongly with the right palm upon the ring, elevating the forearm vertically above it (Fig. 215). Repeat the movement on the left side, press downward with both hands, straighten the arms completely above the rings, and pause in the position indicated by the illustration (Fig. 216). The chest should be fully advanced, the head thrown back, the chin elevated, the legs straight and together, the toes pointed to the ground. In descending bend the right arm again, the left following, repass the right below the ring, follow it by the left, lower the body, and come to the original position. This entire exercise should be repeated in every instance with the left hand leading in place of the right. To rise above the rings with both hands at once

FIG. 215.



FIG. 216.



proceed as above recommended until the shoulders are level with the rings, instantly press forcibly downward with both hands, and raise both arms into a vertical position above them, elevating the body to the full extension of the arms, as was done in the last exercise. The transition from the bent to the extended position of the arms should take place without a pause. In descending flex both at once, pass them below the rings, and come to position.

To rise above the rings backward right and left, make the complete somersault as in the first exercise, and after assuming the position shown

Fig. 217.



in Fig. 214, elevate the right side, lean slightly forward, press forcibly downward with the right hand, and raise the forearm vertically above the ring, repeat the movement on the left, press strongly with both hands, and rise above the rings as in previous exercises. In descending reverse the movements, and then repeat the exercise with the left hand leading.

To rise above the rings backward, both hands at once, take a position as in the first exercise, lift both feet from the ground, pass them between the rings, and at the same time rapidly bend the arms, elevating the body between the rings until the hands are close to the sides, instantly press down with both hands, and raise the forearms vertically above the rings, and, straightening the arms, continue the movement over the circle with the lower limbs, and let the body rise between the rings in the usual posture.

To form the straight line forward, grasp the rings as in the first exercise, elevate the lower limbs to the front, the toes pointed forward, and, the arms being kept slightly bent, allow the head and shoulders to fall to the rear until the lower limbs and trunk form a perfect horizontal line, as exhibited in the accompanying wood-cut (Fig. 217). Finally, relax the extension, let the feet descend to the ground, and come back to the original position. To stand feet upward upon the rings, rise to an erect position with the hands resting in the rings, then incline the head and shoulders to the front, bending the arms and pressing them close in by the sides, and at the same time raise the lower limbs from the rear until the feet are directly over the head, forming, with the trunk of the body, a perfect vertical line, as depicted in the illustration (Fig. 218). Lastly, relax the extension, bring the lower limbs down by the front to the ground, and reassume the original posture.

Fig. 218.



The very difficult feat called standing below the rings, yet supported by them, is thus accomplished: Rise above the rings, assuming the position indicated in Fig. 216; slowly let the whole body descend in position



between the rings, at the same time extending the arms perfectly straight right and left, strongly pressing downward with the palms, until the arms come to be at right angles with the body and perfectly parallel with the floor. Lastly, relax the extension gradually and slowly lower the feet to the ground.

When the learner has gained by practice enough strength and skill to perform all or most of these movements singly, he should proceed to combine two, three, or more of them, executing the compound feat without pause and as rapidly as possible. The simpler combinations will readily suggest themselves, and among the more complicated may be mentioned that of rising above the rings with both hands at once, then forming the straight line above the rings, then turning with the feet in the rings, then extending the arms right and left, and finally forming the straight line forward—all in accordance with the directions already given.

The row of rings should consist of not less than three pair, similar to those mentioned above, but suspended at a height of six feet three inches from the floor, and at equal distances apart, which will be regulated to some extent by the size of the gymnasium. The space between the rings, however, ought not to be less than eight nor more than ten feet, and the ropes by which they are hung should not exceed twenty feet in length. The single exercise on this machine is a very simple one, and may generally be practiced without any supervision by an instructor. Its special object is the equalization of the strength and development of the upper half of the body and of the arms. Its great value, indeed, arises from the fact that only one side of the body can work at a time, and that the amount of exertion will be the same for each side. Hence the weaker side will actually—because it is the weaker—be compelled to put forth more effort, and consequently, according to the unfailing law that development is in proportion to activity, will in time overtake and rank with its fellow in vigor and capacity. The pupil should take a position facing the first ring with his back to the rest of the row. Grasp the ring with the left hand, make a few short, quick steps, and at the end of the run, springing from the ground with the left foot, turn quickly to the right, bending the lower limbs at the knees and pointing the toes to the rear, the head erect and the breast well advanced. On approaching the second ring, extend the right hand and seize it, and whilst retaining it lightly in the grasp, return to the furthest point of the backward oscillation on the ring grasped by the left. At this moment quit the hold of the left, withdrawing the hand lightly, and leaving the ring motionless, turn to the right and bring the left hand in a full sweep round by the thigh, the arm quite straight and fingers pointed downward, describing a half-circle in the sweep, extend the arm to the front and seize the next ring. The same movement is to be repeated with each ring until the last is reached, and on grasping it turn quickly round, facing the row, and descend lightly.

### The Horizontal Bar.

The exercises upon this gymnastic appliance are very valuable for two distinct reasons: first, on account of their own intrinsic merit, and second, from the circumstance that they are capable of being executed by an entire class at the same time, all obeying the same word of command. To some extent they resemble in nature and purpose certain of the more complex movements upon the trapeze. As is always the case with exercises performed by a number of men at the same time, a stricter discipline with a closer observance of time must be preserved. The complicated exercises should all be practiced by the learners separately. The horizontal bar ought to be made of wrought iron, one inch and a half in diameter, and fixed at a height of about eight feet from the floor. It may be of any length beyond twenty feet. Among exercises of travelling along the bar, that with the right hand leading may be mentioned.

The pupil ought to take a position of attention, facing the apparatus, and at the word of command spring from the ground and grasp the bar, the hands at a distance equal to the width of the hips, the fingers and thumb together, the arms straight, the trunk of the body upright, the legs straight and together, the feet in contact with each other, and the toes pointed toward the ground. Next advance the

FIG. 220.



right hand as far as it will reach along the bar, at the same time bending the lower limbs sideways to the left, until the feet are under the left hand (Fig. 219). Quit the grasp of the left hand and immediately pass it along the bar, at the same time allowing the lower limbs and trunk to swing to the right until they are under the right hand; again advance the right hand as far as it will reach, and repeat the movements of the steps. On the conclusion of the last step, resume the first position and descend lightly. This exercise should be repeated with the left hand leading.

In travelling along the bar, right and left hand alternately, commence as in the first exercise, and, after advancing the right hand to its furthest reach, quit the grasp of the left hand, letting the body and lower limbs fall to the left; sweep the left hand round by the thigh in a half-circle, and grasp the bar with it a full reach beyond the right hand, at the same time making a complete turn of the body. Similar movements are to be repeated until the end of the

FIG. 219.



bar is reached. This exercise may be advantageously modified by swinging along from right to left hand backward instead of forward.

To travel along the bar with the arms bent, the right hand leading, proceed as in the first exercise; but after coming into position at the bar, bend the arms so as to raise the chin above its upper edge, move the left hand up to the right, and then advance the right to the length of a step, retaining the trunk and lower limbs in position.

FIG. 221.



Repeat these movements as often as necessary, and at the completion of the last step, when the end of the bar is reached, sink until the arms are fully extended, and descend gradually. In moving along the bar with both hands at once, hold the chin in the position above described, and spring with both hands the distance of a step, retaining the arms bent and the trunk and

FIG. 222.



lower limbs in position. The movement is, of course, to be repeated until the end of the bar is attained.

In order to travel along the bar sideways, with the right hand leading, and the lower limbs hanging pendent, Maclaren's directions are to spring from the ground and grasp the bar with both hands, the right in advance of, but close to, the left, the fingers and thumbs meeting. Next bend the arms until the head rises above the bar on its right side, and the left shoulder is immediately under the bar (Fig. 221,) the

FIG. 223.



lower limbs being held straight and well together, and the toes pointing downward. Then advance the right hand the distance of a step, the left following, the trunk and lower limbs being retained in position, and so on until the end of the apparatus is reached. As usual, this exercise should be repeated, with corre-

FIG. 224.



sponding movements, the left hand leading, and the head on the left side of the bar. It may be modified with good effect, as practice overcomes the primary difficulties, by moving along the bar with the legs bent in a right angle at the knee, in the manner represented in the illustration (Fig. 222).

As an example of the second series of the exercises on the horizontal



bar, may be instanced that of rising above the bar, the right leg acting. To do this, spring from the ground and grasp the bar on its right and left sides with both hands, the left in advance, the fingers and thumbs meeting. Next bend the arms and lift the lower limbs, separating the feet as they rise, pass the left leg over the bar resting on it under the knee, raise the right leg over the left, the calf of the right overlying the instep of the left, the head being thrown back, and the trunk of the body sustained close to the apparatus (Fig. 223). Then quit the grasp of the right hand, pass it under the bar to the opposite side next the body, and grasp the bar, elevate the elbow and rest the forearm along the bar, detach the right leg from the left, straighten it, and rapidly pass it under a bar, with the momentum sufficient to enable the body to rise above it, press strongly with both hands, advance the left leg and rest above the bar (Fig. 224). In descending, reflex the right arm, draw back the left leg, lower the body, and place the right leg over the left, as in the ascent, then detach the clasp of the legs from the bar, straighten the arms, and descend yielding.

#### The Bridge Ladder.

This apparatus, made up of two ladders supported against each other at a very obtuse angle, affords opportunity for a wide range of exercises, which may be made to contribute very agreeably to growth and vigor. The bridge ladder should have a span of thirty feet, and the uprights at each end should be seven feet six inches high, the apex or centre, where the two component ladders meet, being twelve feet from the floor. The width of the ladder itself ought to be fourteen inches, and the thickness of the sides, which must be rounded off to fit the hands, two inches. The spars or rounds of the ladder may be placed nine inches apart.

The first series of exercises by the sides of the ladder is valuable to beginners, whether they are performed with the arms fully extended, as should be the case in the initiatory lessons, or with them bent at the half-reach, as ought to be done when the muscular power of the learner has been so far increased as to enable him to execute them in their perfect form. In the first exercise, the muscles of the upper part of the trunk are most usefully brought into play, and in subsequent ones valuable movements for other parts of the body are superadded. The second series by the spars, is much more difficult than the former, because, during the step from one round to the next, the weight of the body is sustained by one hand in the most trying position, namely, with the forearm bent at a right angle to the upper arm. The double-handed movements which may be performed are especially arduous, requiring and yielding in their practice not only great tension of muscle, but also great rapidity of action, precision, and security of grasp, quickness of eye and decision. Until the action and position of the step have been fairly acquired, the learners

ought to be passed along the ladder singly, the instructor walking by the side and indicating the various points in the exercise to be particularly observed. In the second series, and especially with the double-handed movements, until the learners have attained considerable strength and dexterity, they should not be allowed to pass the arch of the bridge. When the exercises can be executed with sufficient accuracy, the learners should follow each other in rapid succession at intervals of a few feet, returning to the starting-point ready to begin another exercise as soon as the last of the class shall have traversed the ladder. The position of the instructor is by the side of, or behind the learner, in the initiatory lessons; in the more advanced lessons, on the right of the machine.

The first exercise, with the right hand leading, ascending the ladder backward, should be commenced from a position of attention under the ladder facing the upright. In the first place, spring from the ground and grasp the sides of the ladder, bending the arms at the elbow at a right angle, the head held back, the breast advanced, the column of the body held firm and upright, the legs together and straight, the feet together, the toes pointed to the ground (Fig. 225). Next

FIG. 225.

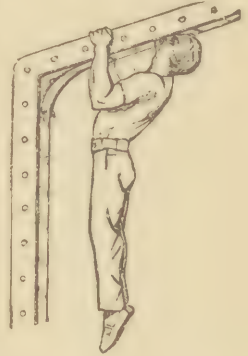


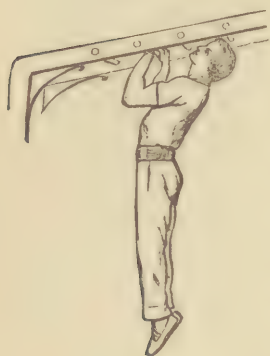
FIG. 226.



advance the right hand about the distance of the space between the spars, the left hand following on the left side of the ladder to a position exactly opposite the right, and so on until the apex of the machine is attained. In descending from the ladder at the completion of the exercise, point the toes toward the ground, lower the body to the full reach of the arms, quit the grasp, and descend lightly. This exercise should immediately be repeated with the left hand leading, in order to equalize the degree of development. Throughout all the movements upon this machine, the body is to be held perfectly firm in the line of the ladder, no swinging from side to side being permitted to occur. The tendency of the body to oscillation being greater after passing the apex of the ladder, it is in the descent that it should be especially guarded against. After some experience is gained, this may be modified as a second exercise, by making each step after the first the length of the two spaces between the spars, the body and limbs being held in the position directed above. In a third modification the mode of progression is by both hands at once,

springing upward and backward a distance equivalent to the space between the spars, retaining the arms well bent, and the body and lower limbs in position. A more difficult variation is to turn the face in the direction of the apex of the bridge (Fig. 226), and advance toward it first with the right hand leading, then with the right and left taking

FIG. 227.



steps of double length, and then by both hands at once, as already indicated. An ascent by the side of the ladder, primarily with the right hand leading, and afterward hand-over-hand, may likewise be practiced with advantage.

The second series, in which the spars or rounds of the ladder are grasped instead of the sides, is not very dissimilar from the first. Springing from the ground, as in the first instance, seize the spar with both hands, the arms bent at a right angle, the palms directed forward, the fingers and thumbs together, the head held back, the breast well advanced, the eyes directed to the next spar, and the body and lower limbs held in the position indicated by Fig. 227. The mode of progression and attitude of the body may be variously modified with advantage in ways which will readily occur to any advanced pupil.

A very simple piece of gymnastic apparatus is the straight plank, which should be fourteen inches wide, one inch and a half thick, and from fourteen to twenty feet long. Its inclination should be frequently varied, in order to change the tension and force of the muscles brought into play. The exercises are all more adapted to the development of suppleness rather than strength, and have the great advantage of being liable at any time, in the unforeseen conditions of every-day life, to prove of great practical value and importance. The first series is performed with the hands and feet, the second with the hands and knees, the third with the legs suspended, and the fourth with the hands only. As an example of these, the mode of progression with the right hand leading may be given.

Grasp the sides of the plank with the hands, the fingers under, the thumb above and pointed upward (Fig. 228). Lift the right foot from the ground and rest it upon the plank, place the left beside it, the legs straight, the feet flat upon the plank, the arms straight and firm, the head held back, the eyes directed to the hands. Next raise the right hand a short distance along the plank, following it with the left hand, incline the body forward, draw up the right foot, and then the left an equal dis-

FIG. 228.





tance, and so on. In descending, slip down the right, and then the left foot following, with the hands in the same order.

### The Inclined Ladder.

The inclined ladder furnishes a series of simple exercises, which are, however, of much practical value, and might at any time in case of fire, conduce to the saving of human life. Instead of the ludicrous uncertainty, hesitation and insecurity displayed by persons who are unaccustomed to ladders, the practiced gymnast will mount one as surely and rapidly as if it were a staircase, in any one of a dozen different ways, as may happen to be most advantageous at the moment. The width of the ladder between the side supports ought to be fourteen inches, and the rounds should be nine inches apart. It should be so arranged that the angle of inclination can be readily varied. The first series of exercises are performed above the ladder, the second series under it, and the third with the hands only.

The simple movements of climbing the ladder in the usual way only require practice; but a few words of explanation may be devoted to the mode of ascending with the feet only (Fig. 229). Stand before the ladder and rest the hands on the hips, then lift the right foot from the ground and place it on the first spar, following it with the left. The feet should be advanced on the spar so that the weight is supported almost on the heel, the front of the leg nearly touching the next round above. The column of the body should be slightly inclined forward, and the eyes also directed to the front. Next lift the left foot to the second spar, straighten the left leg, and bring up the right foot to the same spar, continuing the process as often as required.

FIG. 229.



As an example of the second series of exercises performed under the ladder, that of ascending with the right hand leading is selected (Fig. 230). Standing beneath the ladder, raise the right hand and grasp the spar nearest the reach, the left following, the fingers and thumb being placed together, instead of in apposition. Next lift the right foot, and rest it on the nearest spar, the left following, straighten the knees and trunk, bend the arms at a right angle, advance the chest, incline the body in the line of, and close to the ladder, keeping the head back, however, but the eyes directed to the hands. Then raise the right hand to the next spar, the left following, and repeat the movement with the feet in the same order, straighten the knees and elongate the trunk; proceed in the same manner as far as desired, and in descending, reverse the movement, commencing with the feet.

In ascending by the aid of the hands only, stand under the ladder, and grasp the spar nearest the reach with the right hand, following it with the left, the fingers and thumbs being kept together. Bend the arms at a right angle, lifting the feet from the ground, the trunk and lower limbs assuming the posture shown in Fig. 231, and already described in the account of bridge-ladder exercises. Next raise the right hand to the next spar, the left following, then bend the arms again to a right angle, raising the body, the trunk and lower limbs being retained in position. Repeat the movements until the summit of the ladder is attained, and in descending reverse the process. An arduous modification of this mode of

FIG. 230.



FIG. 231.



FIG. 232.



ascent is by a series of arm-jumps, shooting out both hands at once, retaining the semi-flexure of the arms, and keeping the trunk and lower limbs in position.

### The Rope.

The exercises upon the vertical rope are of great practical value and utility, being still more apt than those upon the ladder to be the means in case of fire of saving one's self, or delivering others from the most horrible of all deaths, that of being burned alive. Besides, practical skill in ascending a rope would often enable a gymnast to rescue a person who has fallen into a well, or been involved in accidents at sea, or upon boats of any description, so that it may at any time prove of incalculable value. The ropes upon which these exercises are practiced may be of three sizes, having a diameter of one inch, one inch and a half, and two inches, and their length may vary from twenty to fifty feet. Evolutions upon the rope naturally divide themselves into two series, the first of which is executed by an effort of the entire body, whilst the second is accomplished by exertions of the arms alone. A much greater variety of exercises can be performed upon a rope than upon an upright pole, because the former admits of numerous methods of employing the lower limbs. The "full

turn" and the "stirrup" (Fig. 238), are, of course, peculiar to the rope, and each affords an admirable method of climbing, both in an educational and a practical sense. Practically the "stirrup" is especially valuable, as the rest in this position relieves the upper limbs, and in great measure sets one hand free to execute any purpose for which the ascent may have been made. This exercise can, of course, only be performed upon a loose rope, and although a comparatively slow manner of ascending, it is generally found to be the easiest for beginners, as it affords a very firm support to the feet; these must only be lifted sufficiently high to bring the hands to the level of the shoulder when the step is completed. The first series should be carefully practiced before the learner is allowed to begin the second, and the instructor should be careful to order a halt as soon as the slightest symptom of fatigue appears.

The pupil must be enjoined about keeping the body perfectly upright in the line of the rope, and held close in with the face at the hands when the arms are flexed. Also in regard to keeping the eyes steadily directed to the reach of the hands, and on no account to direct them downward or far above the reach, or to allow the head to fall from the perpendicular line of the body. Neglect of these rules does not merely involve a loss of equilibrium, but it distracts and divides the attention of the climber, besides giving an appearance of timidity to his efforts. In the event of a slip, strenuous exertions ought to be made to regasp the rope instantly, as the

rope running through the hands of a falling man is liable to cut them to the bone. In all the exercises of the second series care must be taken that the gymnast has no articles of clothing hanging loose or projecting about the breast or waist, especially during the descent. If this precaution be not observed, the hand may grasp these instead of the rope in passing to the rest or point opposite the breast after the sense of touch has been deadened by the climb, and dangerous falls result. It is desirable to have the pupil accustom himself to halt more than once during a long climb, and to change from one method of ascending to another, each time he renews his effort at upward progression. In this way a gymnast can continue his ascent far beyond the distance attainable by a single mode of climbing, because it relieves the parts first engaged by altering the action and position of the muscles concerned.

To ascend the rope, the right hand leading and the foot in the half turn, take a position facing the rope, and raising the right hand grasp the rope with it at full reach of the arm, the left hand following (Fig. 234). Then lift the right foot from the ground and place it against the

FIG. 233.





left side of the rope (Fig. 235), and next place the left foot in front of the rope, the ankles crossing, the outside edges of the feet together, and the rope between them. In this posture straighten the legs, elongate the trunk, holding the chest well forward, the elbows close to the sides, the

FIG. 234.



FIG. 235.



FIG. 236.



FIG. 237.



head slightly bent back, and the eyes directed to the point on the rope which can be reached by the hands when the arms are fully extended. Next raise the right hand to its full reach and grasp the rope, the left hand following, draw up the lower limbs slightly, relaxing, but without relinquishing the clasp of the feet, and with the arms still kept extended as shown in Fig. 236. Lastly, tighten the clasp of the feet when thus elevated, straighten the knees and at the same time flex the arms, lifting the body into position (Fig. 237). The same process is to be repeated until a sufficient altitude is attained, and in descending, of course, the movements are reversed. This entire exercise should

FIG. 238.



always be repeated with the left hand leading, the left foot under the rope, and the right foot above it. As a variation in the mode of grasping the rope with the lower limbs, the foot may be placed in the full turn of the rope. To do this raise the right foot from the ground, and by a circular movement of the rope from the outside inwards pass it round the leg, so as to encompass it by a full turn, commencing on the inner side of the thigh and passing over the outer side of the leg above the ankle, and terminating on the inner side of the foot. The left foot is then to be placed as in the first exercise, and the climb is also similar.

To ascend the rope with the right hand leading, with the foot in the stirrup loop, take the position as above directed, and place the right foot against the rope as before. Lift the left foot from the ground and place it on the

right side of the rope, bringing it up from under the right, with the end of the rope over the instep, rest the front part of the sole on the front part of the instep of the right. As indicated in Fig. 238, the rope is then folded around the right foot, passing under its hollow, and tightly held in its place by the left foot over which it falls. Now straighten the legs and elongate the trunk to the half reach of the hands. At the next step raise the right hand and grasp the rope at its full reach, the left hand following. Slacken the clasp of the feet, draw up the lower limbs without bending the arms, replace the left foot on the right, lifting the rope with it as before, straighten the knees and elongate the trunk to the rest of the hands as previously directed. These movements are to be repeated until a sufficient height has been attained, and after descending the entire exercise must be gone over again, substituting the left hand leading and the left foot placed in the loop.

FIG. 239.



If these simple exercises were generally acquired, and the equally simple precaution of making a stout rope thirty or forty feet long part of the furniture in every bed-room, we might hope to hear but seldom of those horrible accidents of being roasted alive in burning buildings, which from time to time harrow up the feelings of most civilized communities.

The method of ascending the rope hand-over-hand, is to seize the rope as in the first exercise, and then raising the right hand grasp the rope overhead at its full reach, as shown in Fig. 239. Draw up the lower limbs

FIG. 240.



without bending the right arm, straighten the legs and elongate the trunk until the shoulder is opposite the right hand. The next step is a repetition of the movement, raising the left hand to its full reach, and so on alternately until the summit of the rope is attained. Assistance may be derived from the feet placed as already directed in the second and third positions during some portions of the ascent.

For descending the rope a French method recommended by M. Collineau in his elaborate treatise, "*La Gymnastique*," is worthy of attention. The cord is to be carried around the bottom of the foot, and then upward to the height of the shoulder (Fig. 240), where it is held by the hands in contact with the descending part of the rope. When well managed this is a very easy mode of coming down a rope, but some practice in preventing the cord from slipping off the foot and so causing dangerous falls, is necessary before its safety can be depended upon in descending from any considerable elevation.

A much more arduous exercise than any of those already described is that of ascending the rope with one hand. To do this grasp the rope

at the full reach with the right hand, spring from the ground and clasp the rope with the feet as in the first exercise, bringing the right hand to the half reach, that is, raising the body until the face is opposite that hand. Now place the left hand on the hip in an easy position, the posture being that shown in the illustration (Fig. 241). Next tighten the clasp of the feet, raise the right hand to its full reach as indicated in the cut, draw up the lower limbs without bending the arm, then straighten the knees, elongate the trunk, and so on until the ascent is accomplished. This exercise should be repeated with the left hand leading, and varied by adopting the second and third methods of grasping the rope with the feet, in order to ensure alterations of the muscular effort and tension in the most favorable manner.

### The Mast.

Exercises upon the mast, giving as they do the capacity of climbing trees, poles, and so forth, have a great and obvious practical value, but they are especially arduous in their character, requiring powerful and combined effort from the entire frame. The ability of ascending

Fig. 241.



a perfectly smooth column or pillar may be vastly increased by practice. With the young and those who are not very robust, however, this practice should not be long continued at any one time, because during the combined movement constituting the step in this exercise, the mast presses very forcibly upon the front and lower region of the chest, and may seriously interfere with the freedom of respiration. The mast may be of pine, from ten to twelve inches in diameter at the base, and tapering gradually to the top. Its length may be from forty to sixty feet. In a first series of movements the hands and feet are both used, whilst in the second the arms only are employed.

In the first exercise, when the ascent is made hand-over-hand, the pupil takes a position close to and facing the mast, then raising the right hand to its full reach, half encircles the appliance with his arm on its right side, the palm of the hand open, the fingers extended, but touching each other, the left arm following half encircling the mast on its own side under the right. Next lift the left foot from the ground and place it against the mast, the knee toward the left side, the foot toward the right side, the front of the leg crossing the mast diagonally. Then lift the right foot from the ground and pass that leg round the mast, the calf of the leg crossing it diagonally, the trunk of the body being held erect, and the head well back as represented in the accompanying illustration (Fig. 242). To progress in the ascent, now pass the left hand above the right as far as it will reach, draw up the lower limbs and elongate the trunk, pass the right hand above the left,



and complete the movements of the step, which is to be repeated as often as necessary. In descending, pass the leading hand down below the supporting hand, lower the body the same distance, and continue the process until the ground is reached. The hold with the hands may be advantageously varied from time to time by overlapping the hands, raising the right one first and grasping it with the left, which finds a grip on the ledge formed by the fingers and knuckles of the right; or the fingers may be interlaced, the change of position in the hands being made without unlocking them.

To walk the mast, grasp it with the open palms, and place the feet, which should be naked, first the right and then the left, against the face of the pole (Fig. 243). Next raise the left hand, and at the same time lift the left foot, the distance of the step. Then incline to the left, raise the right hand, and at the same time lift the right foot the distance of the step beyond the left, and so on. In descending, slip the leading hand and leading foot

FIG. 242.



FIG. 243.



FIG. 244.



down the distance of a step, repeating the movement as often as is necessary. This is the most rapid mode of climbing the mast, but requires a large amount of both strength and agility, besides being by no means free from danger should the foot slip when far above the base of the pole.

A still more arduous feat is that of ascending the mast by the aid of the hands only. To accomplish this, raise both hands to their full reach, encircling the mast and interlacing the fingers as already recommended. Lift both feet from the ground, bending the arms to their half reach, the legs from the knee pendent on each side of the mast, but not touching, as is shown in Fig. 244. Next shoot up the hands the distance of the reach, retaining the inter-grasp, and by the same action elevate the body, leaving the arms bent at the half reach. These movements are to be repeated until a sufficient elevation has been attained, and then in descending may be reversed. To rest the lower limbs whilst on the mast, detach their hold and let them hang down perpendicularly, a firm grasp being secured with the hands. The arms may be rested one at a time by loosing the hold and letting the favored arm hang relaxed at the side for

a few moments. The pressure upon the chest and stomach ought also to be relieved occasionally by supporting the body by the lower limbs, strongly clasped around the pole, and separating the grasp of the hands far enough to accomplish the desired object.

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### CHAPTER III.

## CALISTHENICS.

LIGHT gymnastics or calisthenics, as this group of movements is also denominated, may be defined as exercises which are performed without apparatus or with such movable instrumental appliances as are easily obtained and readily transported. Whilst calisthenics have some indisputable disadvantages as compared with systematic exercises with machines especially adapted to accomplish the desired objects, their superiority in certain other respects is equally undeniable. In the first place they are better suited to children and delicate adults, especially females, and can be practiced either in large classes under the direction of an instructor, or alone and in privacy with great benefit. Secondly, they may be performed in the open air upon a porch, or close to a raised window, in such a way as to secure the greatest amount of vitalizing oxygen during the time when increased activity of respiration and circulation are brought about by energetic muscular effort. Third, where economy is an object, the absence of all expensive apparatus, or the extremely small cost of what few mechanical appliances are really requisite, constitutes an important recommendation.

One of the most serious disadvantages arising from practicing gymnastics in classes with the more complicated forms of machinery, is related to the supply of fresh, cold air. Since the scholars must be occupied with different machines, which call for different amounts of muscular power, the amount of heat production and, of course, the quantity of cold which will prove grateful and advantageous must vary. Theoretically all gymnastic exercises should be carried on in the open air, and with a reduced amount of very loose clothing. Hence the nearer these conditions can be approximated to, the greater, as a rule, with some notable exceptions, will be the benefits secured.

### The Dumb-Bells.

Of the simpler forms of apparatus dumb-bells are among the more ancient and popular. Much has been written and spoken in favor of heavy as well as of light dumb-bells, but the fact is that the value of each variety depends upon the mode in which it is used. For the elaborate and complicated movements which have been devised for bringing almost all the muscles of the frame into play, light wooden dumb-bells are undoubtedly preferable. On the other hand, when dumb-bells are chiefly employed as heavy weights, and an important object is to put forth energetic exertion by simple movements and in a brief period of time, ponderous implements, some weighing as much as two hundred pounds, have been recommended. A good rule is to begin with dumb-bells each equal to one-fifteenth of the body-weight for males, and one-twentieth of the weight for females. After a few weeks, if implements of this size are not found to call forth a sufficient amount of nervo-muscular energy, they may be substituted by heavier ones. It is advised to increase the weight of the dumb-bells fifty per cent. every time an exchange is effected. The best way of all, however, is to make such alterations of the resistance to be overcome only under the direction of an experienced physician and instructor in physical education, who will prescribe the amount and kind of muscular exercise required with accuracy.

The advantages of exercise with dumb-bells as a primary course for beginners are thus summed up by Maclaren :

1. The dumb-bell is familiar to every one, and has been in use in English-speaking countries for centuries. Its weight and substance are easily recognized, and the exercise it affords is real and effective.

2. It admits of being exactly proportioned to the individual strength of each learner.

3. It can be adjusted to the advancing capacity of the learner, the weight of the bar and bell being augmented as his strength increases.

4. Its exercises give fair employment to all parts of the body and to both sides equally.

5. They are capable of being executed not only by an entire class at one time and by the same word of command, but by many classes or by the entire number of persons which may be present in the gymnasium.

6. The positions and movements are of the highest value as exercises, and directly and powerfully conduce to erectness of carriage and freedom of limb.

A simple and yet efficient mode of practicing with the dumb-bells is as follows : Place the dumb-bells in front of the gymnast in a line with the feet and touching the toes. Step backward a long pace, then forward with the left foot, the left hand grasping the thigh just above the knee as the foot comes to the ground, the right arm extended in the line of the



left leg. Seize the dumb-bell in the right hand, the lower limbs remaining in position, (Fig. 245). Raise the bell above the shoulder, bending the arm during the ascent to full extension leaning strongly on the left knee and pushing the breast forward as the bell is going up. In this position the left leg to the knee and the left arm should form a continuous line from the foot to the shoulder (Fig. 246). Lastly, lower the bell, replace it on the ground in front, and return to the first position. This entire movement is then to be repeated, using the left hand instead of the right.



The second exercise is performed with both bells, one in each hand. Step forward with the left foot, seize a bell in each hand, the arms passing on either side of the left knee. Raise the bells above the shoulders, bending the arms during the ascent to the full extension of the arms, keeping the left knee flexed and pressing the breast forward during the elevation of the bells (Fig. 247). Bring the bells straight down to the sides, replace them in front, and resume the original position. This whole movement is next to be repeated, commencing with the advance of the right foot, thus bringing into play many muscles on the other side of the body which were comparatively inactive in the first position of this exercise.

The third exercise is accomplished with but a single bell, manipulated with first the right and then the left hand. After raising the bell as high



as possible, step forward with the left foot, sustaining the bell at its utmost elevation, and pressing the breast to the front (Fig. 248). Then reverse the process, seizing the bell in the left hand and advancing with the right foot.

In the fourth exercise, where both bells are used, let the pupil step forward with the left foot, take up the bells as in the second exercise, recover the upright posture, and at the same time raise both bells as high

as possible. Step forward with the left foot, retaining both bells at their utmost elevation (Fig. 249), then lower the hands to the sides, step forward with the right foot and repeat the arm movements.

In the fifth exercise, which is especially calculated to strengthen the back and loins, the gymnast steps forward with the left foot, and then brings up the right foot so as to stand astride of the dumb-bells. Stoop from the waist and grasp the bells, (Fig. 250) one in each hand, resume the erect position, at the same time carrying the bells to the utmost reach of the arms, lower them, letting them swing to the rear between the legs, replace them upon the floor, and resume the original position.

After a student or a class of pupils becomes familiar with these various movements, which should be regularly performed, every learner keeping time by counting aloud in unison with the word of command as given

FIG. 250.



by the teacher, the necessary amount of exercise may be obtained by repeating each exercise three, six, nine, or twelve times continuously. They may also be rendered more arduous by increasing the rapidity of the motion and the weight of the

FIG. 251.



implement, and this augmentation of the muscular effort required, may be easily carried to such an extent as to tax sufficiently the strength and endurance of the most vigorous.

Exercise with dumb-bells can be infinitely varied, as pointed out for example in Blaikie's admirable little book entitled, "Sound Bodies for Our Boys and Girls," and in Dr. Dio Lewis's manual of "New Gymnastics."

A French adaptation of considerable value is the two-handed dumb-bell, or bar-bell as it is sometimes called; but, of course, the movements which can be performed with this gymnastic appliance are much less varied in their character.

In the first exercise, the pupil stepping forward to the bell as it lies upon the ground in front of him, seizes the bar with the hands at the distance of the width of the shoulders, the fingers being placed over the rod and the thumbs underneath it (Fig. 251). Next raise the bar above the head, bending the arms during the ascent, but extending them finally to their full reach, pressing the breast to the front, holding the head erect, the eyes directed forward, leaning strongly on the advanced leg and holding the other limb straight and firmly braced back (Fig. 252). Lastly, lower the bar to the floor by a reverse movement, and resume the primary position. This

FIG. 252.



exercise ought to be immediately repeated with the left foot in advance, in order to equalize the development of the two halves of the frame.

Modifications of these movements, similar to several of those already directed with the ordinary dumb-bells, can be readily devised by any one, and serve to agreeably diversify the kinds of exercises such appliances afford.

Exercises with simple wands or sticks take an important place in the French system of gymnastics, and also in that of Dr. Lewis, contributing greatly to grace of carriage and movement in the upper part of the body.

FIG. 253.



The shoulder-joints are especially improved in suppleness, so that the sphere of their movements is rapidly enlarged. One of the important ulterior advantages is the augmentation of the cavity of the chest, and consequent increase of the breathing capacity. A sufficient idea of the evolutions performed with wands may be gained from the accompanying figures. The baton may be grasped and raised from the ground by the pupil, who steps a long stride in advance to seize it, and in the first position raises it to a line

opposite his shoulders. Next retaining the hold of one hand only, and placing the other hand on the hip, as shown in Fig. 254, elevate the wand to the full reach of the arm, preserving its exact horizontal position. Next grasp the baton with the left hand again, and bring it to a vertical line, with one end resting on the ground, bending the body and limbs without inclining or curving the rod from its exact per-

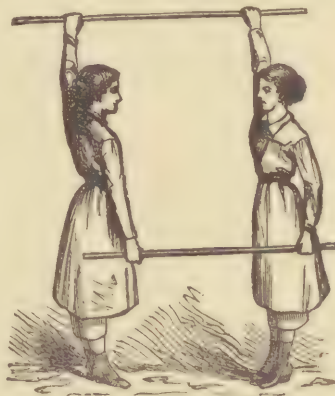
FIG. 254.



FIG. 255.



FIG. 256.



pendicular position (Fig. 255). Lastly, reversing the rod, bring the other side of the body into play, so as to keep up the great principle of equalization.

Pupils exercising in couples may advantageously modify these simpler movements by combining their rods into pairs, and raising the batons,



first one, as shown in Fig. 256, to the full extent of the arm, then following it with the other, afterward stretching out both arms in a horizontal direction to the uttermost limit, and so on in great variety. Such combined exercises in which two or more take part, cultivate ease, quickness, and precision in each partner to a high degree. Another great advantage they possess is the tendency to develop the muscles which hold the head erect, and the shoulders well back, thus going far to correct the dangerous stooping shoulders and bowed head so lamentably common among scholars who bend much over their books, as well as in older persons who lead sedentary lives.

### The Indian Clubs.

Indian clubs are, as the name implies, an Oriental invention, and have only been introduced into America within the last twenty or thirty years. Among the Hindoos, performers exhibit great muscular development and Herculean strength. An officer of the Anglo-Indian army writes, that the wonderful club exercise is one of the most effectual kinds of athletic training in common use throughout India. The fantastic motions are among the best exercises ever known. The clubs are of wood, varying in weight according to the strength of the person using them, but generally for an adult man they have a length of two feet and a half, and are some six or seven inches in diameter at the base, which in the original form is flat, as represented in the figure, so as to admit of their standing firmly on the ground, so affording great convenience for using them in swinging positions. The club exercise is in great repute among the native Hindoostanee soldiery, police, and others whose caste exposes them to emergencies where great strength of muscles is desirable. The evolutions which the clubs are made to perform in the hands of one accustomed to their use are exceedingly graceful, and they vary almost without limit. Beside the great recommendation of simplicity, Indian-club practice possesses the essential property of expanding the chest, and simultaneously exercising almost every muscle in the body. So valuable was the Indian club exercise found to be for soldiers, that soon after the establishment of English colonies in India it was introduced into the British army as part of the drill.

A vast number of complex movements may be performed with these appliances which it would require a small volume to fully describe. The following simple motions form a basis for the more complicated varieties.

The clubs are to be seized, one in each hand, and grasped firmly close to the terminal ball of the handle, the thumb being stretched out toward the other or outer extremity, in order to gain a more complete control of the movements of the implement. Then assume an erect military posture, and bring the clubs into a perpendicular position, each in front of the corresponding shoulder. Next carry the outer ends of the clubs forward to the full reach of the arms, keeping the arms and clubs exactly parallel. Now swing the clubs upward and then backward, letting them fall into

position behind the upper part of the arm, as shown in the illustration (Fig. 258). As a third exercise, restore the clubs to the first position, and circling them upward as high as the arms will carry them, bring them down over the back. In this posture the head should be thrown backward and the chest expanded to its uttermost, so as to aid the movement in promoting the due inhalation of copious draughts of air in the

FIG. 257.



FIG. 258.



FIG. 259.



lungs. From this position, as shown in Fig. 259, swing both clubs at arms-length in a graceful curve to the front, and then backward to the full reach of the extended arm, return with both until the clubs are per-

FIG. 260.



pendicular over each shoulder, and from that point of greatest elevation let the implements fall until they and the extended arms supporting them constitute a horizontal line, as shown in Fig. 260.

On the foundation of these similar movements of both clubs, may be built up at the fancy of

the performer, beautiful but intricate and complex evolutions, in which the two implements seem to a novice inextricably entwined together, and constantly on the verge of inflicting dangerous concussions upon the head of the unsuspecting operator.

### The Swedish Gymnastics.

We come next to a consideration of the important group of light gymnastics, which are so light that they are performed without any appliances

whatever. This system has the great advantage that it can be operated at any time, and in any place, without expense or inconvenient preparation. It is, therefore, especially adapted for use when temporarily away from home, or whilst travelling, and its efficacy is such that Prof. Hartelius, one of its prominent advocates, declares man has in his own organs of movement an efficient means for the preservation of health, and for its restoration when disturbed, provided he will, and knows how, to make an appropriate use of this means. As these exercises may be performed in any private apartment, it is necessary to remind the reader that care should be taken to have the room well ventilated with air which is thoroughly fresh. A chamber which has been shut up for some time, even though its temperature is quite low, is by no means suitable for a gymnasium, and the great truth already so often insisted on, that cold air is by no means necessarily pure air, must always be borne in mind.

The first of these exercises, entitled in the complicated nomenclature of the famous Swedish movement-cure, "Standing arm-raising sideways, upwards," is pursued as follows: The stretched arms are moved slowly outward and upward, from a posture where the hands rest upon the outside of the thighs, until they attain a vertical position above the head, as shown in Fig. 261. Whilst moving to this position the arms are gently rotated, so as to make the palms face each other, with the fingers fully stretched out, when the highest point is attained. The head and chest are to be held erect, the chest arched forward, and the arms kept well back during the movement. Without delay the arms are to be again lowered through the same plane until they resume their original position. The entire exercise, of which a side view is afforded by the marginal illustration (Fig. 262), may be repeated from eight to sixteen times, according to the strength and experience of the pupil.



FIG. 262.



FIG. 261.

Persons who have a difficulty from any cause in standing may perform this and similar movements in a sitting posture. The effect of such an exercise is to cause a stretching of the back and neck, and a pulling back of the shoulders, by bringing the muscles of the spine and neck into action. The forearms, hands and fingers being also kept on the stretch, their extensors are likewise contracted during the movement. But the muscles which are brought most forcibly into operation are those which



elevate the arms. The ultimate effect is to widen the chest and increase its mobility. It is an appropriate motion in general weakness, nervous debility, anæmia, weakness of the chest, and difficulty of breathing. Enfeebled individuals may at first experience some difficulty in raising their arms up to a vertical posture several times in succession. Under such circumstances it is best to stop short when the arms become horizontal, until after strength to complete the exercise in its perfect form is gained through practice.

In a second exercise, called standing arm-circling, the stretched arms are slowly moved straight forward, upward, and sideways, then down

FIG. 263.



again in such a manner as to describe a circle of which the shoulder-joint is the centre (Fig. 263). After some practice the slow measure may alternate with a somewhat quicker performance. During this exercise the muscles of the back, and those of the back of the neck, should be exerted to keep the spinal column and the head perfectly erect. The hands ought also to be stretched by their extensors. These movements act energetically upon the shoulder-joints, increasing their strength and mobility. They also widen the

chest, and have a tendency to relieve congestion of blood in the head, and also in the thorax. After some practice this exercise may be advantageously modified by making the upward movement of the

arms very rapidly, with a quick jerking motion, so as to have a more powerful influence not only upon the muscles involved, but also upon the balance of the circulation.

FIG. 265.



FIG. 264.



An excellent exercise for overcoming the disposition to round shoulders, with which so many scholars are afflicted, is that indicated in the accompanying illustration (Fig. 264). The position of the arms at first is with the clenched hands just in front of and almost in contact with the shoulders, which should be well drawn back. From this posture the arms are to be suddenly thrust upward to their full reach, and then slowly returned to the

primary position. The process should be repeated from eight to sixteen times daily, and its beneficial effects upon the vigor and beauty of development are often speedily apparent. As in others of these exercises,

it is essential not to hold one's breath during the movements, but to regularly draw in quiet and deep inspirations whilst performing them. Another useful method of strengthening all the muscles about the shoulder-joint, is to move them slowly round so that the outermost and uppermost parts of the articulation describe a circle (Fig. 265), which, although at first small, may gradually by practice be increased until a diameter of eight, ten, or even twelve inches is attained.

For invigorating the large flat muscles upon the front and back of the chest, which are so important in their relations to the respiratory process, the exercise entitled in the Swedish nomenclature wing-standing, elbow-moving backward, is to be highly commended. The hands are placed upon the hips, the thumbs directed forward and the fingers backward, the elbows being held a-kimbo (Fig. 266). From this position the elbows are slowly moved backward as far as possible without any violent effort, then allowed to resume their original position, and so on until the movement has been repeated eight or ten times. The head and spine should be held erect, or even a little beyond the perpendicular, the shoulders thrown well back, and the expansion of the chest energetically promoted in every way. The favorable effect of the combined movement is to counteract a tendency to flatness of the chest, and its resulting predisposition to consumption.

FIG. 266.



FIG. 267.



In standing, arm-bending, and stretching upward, the forearms are quickly flexed upon the upper arms, the fingers slightly bent and kept pointing toward the shoulders, and the elbows kept close to the sides (Fig. 267). From this position the arms are sharply and energetically stretched upward, as indicated in Fig. 261, to a vertical position above the head, the entire movement being repeated from eight to sixteen times. The arms should then be stretched as quickly and forcibly sideways instead of upward a similar number of times, and the exercise may be usefully modified by directing the extensions forward and then backward, each for a like number of efforts. Each of these arm-movements, and still more the entire combination of them, increases the suppleness and strength of the elbow-joints, and tends to widen the framework of the chest. Thus the arm-stretching upward widens the chest more especially in its lower and middle parts. The arm-stretching sideways expands the thorax particularly in its posterior and middle portions. Arm-stretching forward

causes the hinder and lower parts of the lungs to take in more air. If in arm-stretching backward the head, neck, and spine be kept perfectly erect, and the shoulders drawn backward, this movement causes a widening of the chest in the process of raising the upper ribs by means of a passive stretching of the muscles attached to them. But besides this strong action upon the muscles concerned in the movements, these flexions and extensions of the arms in different directions have altogether a wide-spread and powerful influence on respiration and circulation, so that they deserve an eminent place in the list of means for a general strengthening of the body. They are recommended as a specific remedy against weakness and rheumatic pains in the joints concerned in performing these movements. To individuals whose breathing powers are feeble, as is so apt to be the case with those who lead a sedentary life, these exercises are exceedingly valuable, not only on account of their invigorating the organs of respiration, but also in consequence of their stimulating effect upon the digestive functions, so useful in all cases of nervous and general debility, and of impoverishment of the blood. Indeed, the tonic efficacy of these movements seems to have been foretold in a fanciful sort of a way by the illustrious Dr. Boerhaave as follows: "When I reflect," says he, "upon the immunity of hard-working people from the effects of wrong-feeding and overfeeding, I cannot help thinking that most of our fashionable diseases might be cured mechanically instead of chemically by climbing a bitter-wood tree, or chopping it down if you like, rather than swallowing a decoction of its disgusting leaves."

In cases of chronic catarrh or bronchitis, these exercises are also useful for relieving the engorged lungs of blood, which is forced out of the thorax into the active muscles of the arms. Persons with weak chests must, however, employ them with due precaution, and in patients with severe disease of the heart or lungs, they should not be resorted to without the special advice of a physician. In order to render the exercise more arduous, and its effects therefore in suitable cases more actively beneficial, the exercise may be modified by flexing and extending the arms in these directions alternately instead of together. Under such circumstances, the respective positions of the arms should be exchanged several times during the performance.

A simple but useful movement, valuable for strengthening the shoulder-joints and muscles of the arms, as well as for relieving the thoracic organs when engorged with blood, is that called cross-standing arm-rotation, inward and outward. During this exercise the arms, previously stretched out at right angles to the body, are rotated round their long axes inward in pronation, and outward in supination. This rotary movement is executed partly in the shoulder-joint, and partly by the radius being rotated around the ulna, carrying, of course, the hand with it.

Hand and finger-movements, though of great importance, are unfortu-



nately too apt to be neglected. They bring into play nearly all the muscles of the forearm, and exert a direct influence on the joints of the wrist and fingers. The first set of motions consists in alternately bending the tips of the fingers so as to touch the front of the arm above the wrist, and stretching out the hands as far as possible backward; also in bending the hands sideways first in abduction, that is toward the thumb, and then in adduction, or toward the little-finger side. The second set of movements is made up of a simultaneous and energetic bending of all the fingers, followed by a stretching in the same manner, to be repeated

FIG. 268.



FIG. 269.



from eight to sixteen times. The third set consists in energetic spreading out and shutting in of the fingers, held fully extended, the motions being similarly repeated.

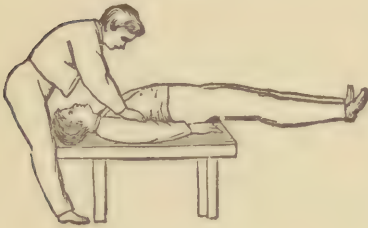
Among the leg-movements, that of alternate heel-and-toe-raising is valuable as bringing into play a large number of the muscles of the legs and feet. This exercise, which is sufficiently described by its name, is recommended as a remedy against cold feet, which are so apt to trouble persons who lead a sedentary life, or those who suffer from impoverishment of the blood.

Foot-circling may be performed either standing with the hands placed firmly on the hips, or sitting with a support for the back. If performed in the erect position, the leg ought to be stretched forward, and the foot made to execute a circling motion, as indicated by the dotted lines of Fig. 269. This should be repeated several times, first to one side and then to the other. If done in a sitting posture, one knee ought to be crossed over the other, or when both feet are engaged the legs should be stretched forward, the heels resting upon the floor. This exercise is valuable for increasing the mobility of the ankle-joint, making the feet

warm, and for withdrawing from the central organs of the nervous, circulatory, or digestive systems an excess of blood.

An exercise entitled lying-leg-circling, which usually requires the assistance of a schoolmate or teacher, is represented in Fig. 270. The head and trunk should be allowed to rest upon a firm, solid support, whilst the legs are made to perform simultaneously a circling motion, first to the right and then to the left.

Fig. 270.



This exercise acts upon the abdominal muscles and those surrounding the hip-joints, and has a specially blood-relieving and strengthening effect upon the organs in the pelvis, being

therefore particularly useful for females. If performed with the arms stretched above the head it very favorably promotes respiration.

A good combination of the knee-bending and leg-stretching movements, consists in bending the lower limb upward until the thigh forms a right angle to the trunk, and the same angle with the leg proper (Fig. 271).

Fig. 271.



Fig. 272.



Next stretch the leg out to its full extent, so that the entire lower limb is horizontal, the point of the foot being held foremost during the whole operation. Then the knee ought to be again bent, and the foot placed down heel to heel with the other one. The same movement should be made with the other leg, and so on alternately. The knee should then be bent backward as far as possible, and afterward a similar movement sideways may be performed.

Fig. 273.



In standing-leg-circling (Fig. 272), the leg describes a wide circling motion, directed forward, outward, and backward, the same movement being repeated with the other leg. This and the preceding exercises require a precision and readiness in the action of the muscles, so that they can seldom be well performed by one who has not had some experience in them. By practice,

however, they gradually increase the power of balancing and the influence of the will over the muscular system, tending at the same time to render the lower extremities supple and elastic.

The exercise denominated wing-standing alternate knee-lifting, is thus effected: The hands are placed on the hips, the knees are alternately lifted in a bent position as quickly and as high as possible, without any

FIG. 274.



too great exertion (Fig. 273). Thus the weight of the body is thrown first on one foot and then on the other, the toes touching the ground primarily. The head and trunk should be kept quiet in an upright and easy position, with the chest well arched forward. The exercise may begin in a slow walking

FIG. 275.



measure, and then gradually increase in rapidity until it attains the rapidity of running. Under the latter circumstance it becomes very arduous, and care must be taken not to carry it to excess. The advantages of this exercise are, that besides strengthening the lower extremities, and rendering them supple and agile, it greatly stimulates respiration and circulation, thus producing a genial and agreeable warmth.

Another arduous limb-movement, represented in Fig. 274, is that in which the pupil lowers the body by bending the knees until the back of the thighs rests upon the calves of the legs, the arms being carried forward to assist in balancing the body, as represented in the figure. Then, after counting *one, two*, he slowly raises the body by straightening the legs, bringing the arms to their primary position at the sides.

The movements of the trunk may be performed in the following main directions: bending forward (Fig. 275), backward, and to the sides, and also by performing rotation upon its long axis.

The trunk may likewise be made to describe a circle, which is really the result of a combination of the consecutive bendings of the trunk, in all the above mentioned directions. This movement, which is called "wing-stride-standing, trunk-circling," is performed by moving the trunk from the waist, describing as large a circle as possible, first to the right and then to the left. At the commencement the hands should be rested on the hips, the feet placed parallel to each other at a distance of twenty-four inches, and the legs ought to be kept

FIG. 276.





straight throughout the entire exercise (Fig. 276). The movement is accomplished chiefly by means of the muscles of the trunk situated around the hips. It causes a general compression of the viscera of the abdomen, and tends to relieve constipation. By its influence in alternately shortening and lengthening the great blood-vessels, it promotes the circulation of the blood, more especially in the abdominal cavity. It often seems to have a beneficial effect in diseases of the pelvic viscera, such as uterine, or vesical catarrh, and in hemorrhoids.

The exercise called trunk-raising, is useful in promoting digestive and peristaltic action, and is therefore to be recommended in dyspepsia and constipation. It must not however be undertaken by those who are the

subjects of hernia, and when there is any tendency to this disease, it should be cautiously employed. The whole upper part of the body and limbs, as far as the knees, should repose on a low table or high stool, which, as shown in Fig. 277 is just elevated sufficiently to allow the soles of the feet to rest firmly upon the floor, as

FIG. 277.



when sitting. Some pressure should be applied to the knees, either by the hands of a schoolmate or by a leather strap fastened to the table, to enable the operator to raise the head and trunk steadily, keeping the spine quite stiff until a sitting posture is assumed. From this position the performer should slowly lie down again upon his back, and repeat the entire movement from three to six times.

The movements of the head, or, more properly of the neck, consist of bending forward, and backward, or sideways, rotation, and circling, or moving in circumduction. None of these call for great muscular effort, but they are, nevertheless, useful in promoting the growth and development of the cervical muscles. They counteract and often cure stiffness in the joints of the neck, and promote circulation of blood in the brain, especially if performed with deep breathing. Consequently they often prove beneficial in cases of headache, and other disorders which arise either from excessive or deficient supply of blood to the brain.

FIG. 278.



Among the complex exercises, the following, classed among pass-positions, with foot and arm changing, is especially valuable. It is essentially the same form of movement as the fencing-pass. The feet are placed at a right angle, the heels together, the arms bent at the elbow-joints, the

fingers pointing toward the shoulder. Next the left foot is moved outward and placed firmly on the floor, at a distance of three foot-lengths from the heel of the right foot. At the moment the foot touches the ground, the left knee is bent, so as to stand just over the ends of the toes, and the weight of the body is thrown upon this leg. The other leg is stretched out, so as to form a straight and slanting line, as represented in Fig. 278, with the trunk and head. Simultaneously with the left foot assuming the described position, the left arm is thrust forward, and raised above the head, and the right arm thrown backward. Lastly, the erect position with the heels together and the arms bent, having been resumed, the same movement should be performed on the opposite side with the right foot and arm. This exercise may be beneficially modified by placing the left foot at starting three foot-lengths outward and backward, or again the same distance directly forward, or equally far in a direct line backward. It should be performed slowly at first, but when due accuracy is acquired by practice, it may be hastened until accomplished with great rapidity. It brings about a very extensive nervous and muscular action, so that it has a generally stimulating and strengthening effect, besides producing elasticity and ease of bearing. It can rarely be accomplished accurately by persons who have not acquired some skill by previous practice in simple exercises.

It must be borne in mind that the organs of movement in every human being possess, not only the power of executing an almost infinitely varied series of motions, but also the capacity for attaining by practice, an astonishing degree of perfection of purity and beauty of form, in each one of them. What an immense difference exists between the tottering steps of an infant, or the want of precision in the movements of the fingers whilst trying to write or play a piano, in an untrained person, and the great perfection of execution of a practiced dancer or a skilled musician? Any exercise which, whilst in strict accordance with physiological and hygienic laws, is calculated to overcome our natural awkwardness, and bring about ease, precision and a general sense of equilibrium in movement, is valuable far beyond the local benefits which it confers upon the portions of the muscular system involved. It is by the use of such exercises that the will acquires full dominion over the so-called voluntary muscles, and enables them to perform their movements in accordance with the ideal formed in the mind. Indeed, a perfect analogy exists between the physical usefulness of these movements, and the intellectual value of the methodic mental exercises of the brain, by means of which the mental faculties are educated up to the full measure of their wonderful development.

### Walking.

Walking is the chief means by which most people secure that fraction of a due share of exercise, which they ought to take in order to keep themselves in perfect health, and it is therefore worthy of especial consideration in this chapter.

The process of walking is as difficult to describe as it is simple to perform, and as hopeless of clear explanation as it is common in its performance. In order to analyze the muscular movements involved, let the reader stand up and go through the following programme. First, stand erect with the heels together and the toes slightly turned out. Second, advance the left foot a short distance, so that its heel is on a line with the great toe of the right foot, and six inches to its left side. It will be felt that, on doing so, the whole weight of the body is sustained by the right leg. Third, throw the weight of the body gradually forward, and it will then be perceived that the weight gradually leaves the right foot and comes to be sustained by the left. At the same time, the muscles on the outer aspect of the left hip, and those of the calf of the right leg, are felt to become active, the first set having an effect in pulling and the second group in pushing the body forward, at the same time the pelvis has an inclination towards the left. Fourth, throw the body still further forward; this has the effect of transferring the weight still more to the left foot, the right one touching the ground only opposite the ball of the great toe. Fifth, when the toes of the right foot are raised from the ground by the muscles of the front of the leg, the whole weight is sustained by the left foot, and all the muscles in the front of the leg, thigh, and outer aspect of the hip of that side, are found to be tense and strongly contracted. Lastly, the right limb is now swung forward, and a repetition of the process produces the movement of walking.

In ordinary walking every individual has his own particular step, conditioned by the relationship, conformity, and length of his bones, and the height of his frame. The step of a friend can often be recognized by hearing his tread, and even at a distance a man's gait will often assure us that he is a person of our acquaintance. This indicates that there is a natural step for each individual to fall into, and it seems to be adopted quite involuntarily. Such a thing, therefore, as a regulation step, enforced in military training, is totally unnatural, and must eventuate in immense loss of marching power. In a regiment on the march, a drummer boy has to stretch his legs to the utmost, and the man of six feet is compelled to restrain the natural swing of his limbs in order that he shall not outstrip his shorter comrades. This military necessity of adapting all the steps to one standard involves extra muscular exertion in at least nine-tenths of a regiment, and causes fatigue much sooner than if each soldier were allowed to choose his own gait. As a result of this loss of power in



regulating the step, regimental marching is slower than ordinary pedestrianism, even if the additional weight of the soldier's outfit is taken into account.

From all these facts we may conclude that when one desires to walk quickly, as in a long-walking competition, the length of step, the number of steps per minute, the gait, and the height the feet are raised from the ground, should all be left to individual selection.

The moment walking comes to be up-hill work, the fatigue is markedly increased. The centre of gravity of the body is altered, and the muscular force necessary to provide for the change causes a fixing of the diaphragm, and a rigid condition of many other muscles. The breathing is interfered with by this rigid contraction of the midriff, and the heart becomes affected thereby. In certain forms of heart-disease, when the heart is very sensitive, the patient can tell during a walk when a rise in the ground occurs, which is otherwise well nigh imperceptible. Climbing up a hill or going up stairs calls for increased expenditure of force under the most favorable circumstances, but many people render them unnecessarily exhausting by a habit of partially suspending the breathing. Let the reader hold the breath whilst running up twenty-four steps of a staircase, and then perform the same act breathing freely and deeply. It will generally be found that by the first ascent, panting and breathlessness are produced, whereas by the latter the effect is much less marked. So it is with any muscular action which is continued for any considerable length of time, and in proportion as the breathing is obstructed will fatigue rapidly occur. It is the skillful management of the breath in walking, and still more in running, rowing, and so forth, that constitutes the great difference between the beginner and the trained athlete. The muscular force expended in going up stairs is very great, even when the pace is slow. It has been calculated that to ascend seventy steps, each six inches high, a man of one hundred and fifty-four pounds must exert a muscular force of nearly two and a half foot-tons, or about the equivalent of a walk three-eighths of a mile in length on level ground. But this estimate does not represent the amount of fatigue really induced by ascending a long staircase, because the operation is usually performed hastily, and the rate is an important consideration, in consequence of the strain brought upon the heart and lungs by rapid muscular movement.

Among the most evident effects of a brisk walk, we notice that generally the color comes into the cheeks, the temperature of the body is raised, the breathing is quickened, the pulse beats more frequently, and the skin grows moist. Subsequently, as a rule, the appetite is increased, and the digestion improved. Most of the important muscles of the frame, except those of the arms, are more or less brought into play whilst walking. The body must be held erect by the muscles of the trunk, and, of course, those of the lower extremities are in full activity.

The effects of brisk-walking exercise upon the internal organs are very important. In consequence of an unusually large amount of carbonic acid being brought to the lungs by the veins, from muscles which are actively employed, respiration is hastened in order to eliminate the waste products, and to take up an increased supply of oxygen. The augmented activity of the respiratory process necessarily quickens the heart's contractions, which propel the blood more energetically, not only through the muscles which are in operation, but throughout the whole system. This quickening of the flow of blood through the liver, stomach, and other abdominal organs, as well as the increased motion conveyed to them by the augmented rapidity of the respiration, has a most valuable effect in promoting the digestion and assimilation of food, and consequent improvement of nutrition.

The influence of walking on the breathing is marked not only in regard to the rapidity of the respiratory acts, but also as respects the quantity of oxygen inhaled, and the amount of carbonic acid eliminated. The ordinary amount of air inspired when the body is at rest is estimated at four hundred and eighty cubic inches per minute, but when walking at the rate of four miles an hour this quantity is more than quadrupled. Several important lessons are obviously deducible from this observation in regard to the enormous excess of air requisite during exertion. In the first place it is obvious that exercise ought to be taken in the open air, and not in any confined apartment, even though fairly well ventilated. Secondly, active muscular exertion should be indulged in only when the free play of the lungs and heart is unhindered by tight clothing, bandages, or braces of any kind. Close-fitting straps about the chest, or tight belts around the waist, are injurious at any time, but particularly so during active exercise.

The moisture of the surface during violent exertion is an obvious indication of activity of the skin. Provision for getting rid of this excretion must be made, just as ought to be done for exhalations from the lungs, and it is important to remove perspiration by frequent change of clothing, and by bathing. The best garments for gymnastic exercises are made of flannel, because it is the best absorbent, but on this very account flannels should be frequently changed and washed.

In youth, manhood, and even in the decline of life, at least up to sixty or sixty-five, walking usually forms the most available form of exercise for business and professional men as well as ladies and children. The manifold evils entailed by an otherwise sedentary life may often be counteracted by a "constitutional" of from four to eight miles daily, and the value of this important sanitary measure is vastly enhanced if the mind is agreeably occupied by congenial society, or the pursuit of some object in nature or art.

### Running.

Running consists in taking a series of short, rapid, forward jumps or springs off of each foot alternately. In running the body actually hangs unsupported for a time in the air, and this constitutes the great difference between walking and running. In the former of these modes of progression one foot is always on the ground, in the latter the leaps throw the body upward, so that for the fraction of a second both feet are off the ground. The chief cause of the rapid advance in running is the increased number of steps taken in a given time, the distance covered at each step not being much augmented. Soldiers at quick march take a step of thirty inches, and at double-quick thirty-three inches at each pace. The number of paces, however, is increased from a hundred and sixteen

FIG. 279.



to a hundred and sixty-six per minute. This step increases the distance passed over from one hundred and eighty-seven feet per minute in walking, to four hundred and fifty-three feet in running at the double-quick, or a little over a mile in eleven minutes. But this is slow movement compared with what has often been accomplished in running races. The soldier is hampered by being compelled to carry his outfit and accoutrements, but in running races the burden is reduced to a minimum, and the speed is relatively enormous. The number of steps taken per minute is found to diminish as the distance increases. Augmenting the number of steps per minute affords the greatest gain, as far as speed is concerned, but when long distances have to be covered the length of the step is an important element toward success. Short and long steps, however, cannot be taken at the pleasure of an individual. A man of low stature has a step natural to himself, and it is of necessity shorter than that of a tall man. A person six feet in height is not apt to be a good short-distance



runner, whilst a man of five feet four inches may be a good short-distance runner, but cannot be first-rate at a long distance, when increased length of the step is an important element to success. A man five feet seven or eight inches high can adapt himself most easily to either one or the other, and it is from men of this height that superior runners for both short and long-distance races are chiefly recruited. A tall man who can move his lower limbs quickly, will, of course, possess a great advantage, as he covers more space at each stride than a shorter man does, but long legs are, as a rule, neither capable of, nor adapted to the taking of quick steps.

The best period of life for training, so as to attain high speed and great endurance in running, is from twenty to thirty years.

In practicing running, the commencement should be made with slow time, and the position primarily assumed is the same as in walking, except that the arms are bent at the elbows, the forearm held in a hori-

IG. 280.



zontal line, the hands to the front and closed, the thumbs turned inward.

The actual movements which are made by a human being in the operation of running have long been a matter of dispute, and it is only within the last few years that, thanks to the discoveries and inventions of Mr. Muybridge and Mr. Marey, and by their ingenious applications of instantaneous photography, we are fully informed on this interesting subject. The wood-cut on page 985 (Fig. 279), representing the positions assumed at five different periods in a running step, will give an excellent idea of the real nature of this mode of progression. As there shown, the step is similar to that of walking, except that the left foot, for example, as already stated, is lifted before the right reaches the ground, and is raised to a greater elevation, the knees are more bent, and the column of the body is pressed more strongly to the front. The slight differences in attitude during the adoption of the different rates of movement, are well displayed in Fig. 280. When a man commences running, he should begin with trying to run a mile at the first, or "slow" pace, striving to cover the distance in eight or nine minutes. A good

plan is simply to break from his walk to the running track, into an easy trot, and practice it day after day until he finds his wind decidedly improved and the work pleasurable. As he gains by practice, let him gradually increase his speed, and when the mile can be done in six minutes, as easily as it primarily was accomplished in eight, the uniformity of the run may be broken, and variety of pace cultivated. The first quarter of a mile may be covered at the original easy trot, so as to let the organs of circulation and respiration gradually take on the accelerated action demanded of them. The second quarter of a mile may be done in the same way, but with a quickened pace, still keeping within the margin of easy performance. Then let the third quarter of a mile, if the preceeding exercise causes no distress, be quicker still, gradually culminating towards its close in an effort at speed to the utmost strain of the physical powers. Lastly, let this effort subside in the fourth quarter gradually into the first easy trot, with which the prescribed distance is finished.

### Leaping.

The exercise of leaping may be considered as composed of a modified step, and especially when preceded by a run, the jump is but the terminating step of the course. The simplest form is the standing leap, which embraces a very extended series of movements, all more or less valuable in preparing and strengthening the lower limbs for the more arduous modes of leaping, and for enabling the leaper to bring the upper limbs, and the trunk itself to aid in the effort. There are few exercises in which men improve so rapidly and to so great an extent as in the various modes of leaping; and there is scarcely any one which so powerfully contributes to the development of the lower limbs. This is because the action in jumping is precisely that which the nature of the muscles themselves demand for their healthful growth and full development, namely, rapid expansion and contraction, with progressive and accumulative effort.

In leaping *height*, the pupil should never be allowed to jump at a stiff barrier, because it in no wise tests the power of the leaper better than a fragile one, and it introduces a totally unnecessary element of danger. The barrier for leaping over should be formed of two standards six feet high, and set six feet apart. Between these a strong string, with a small flag in the centre, should be stretched, being looped around one of the posts, and lightly fastened to an iron pin loosely set in one of a row of holes, bored one inch apart, in the back of the other standard.

To leap *height* in two movements, take a position at a short distance from the barrier, bring the arms upward and forward to their full reach above the head, the hands being closed, and swing them downward again to their full extension, at the same time bending the knees until they project over and beyond the toes, raising the heels and bringing the

weight of the body on the fore-part of the feet. Repeat this movement three times, and after the third depression of the body, spring from the feet, and clear the barrier in the position shown in Fig. 281, descending lightly to the ground on the opposite side.

To leap *width*, take a posture of attention, with the toes at the edge of the transverse mark. Next bring the arms slowly upward and forward to the line of the shoulder, the fists being firmly clinched. Swing them

FIG. 281.



FIG. 282.



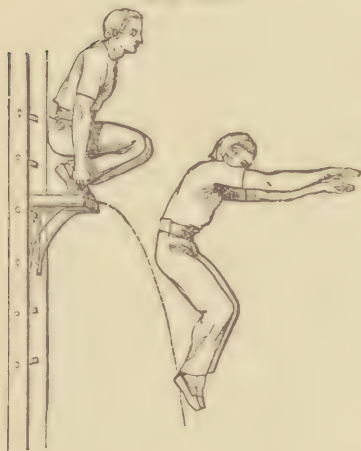
FIG. 283.



again downward and backward to their full extension, at the same time flexing the lower limbs, and repeat these movements three times. Then spring from the feet, with the entire force of propulsion of the lower limbs,

and at the same instant throw the arms to the front, as shown in Fig. 282. Lastly descend lightly, but let the entire soles of both feet meet the ground at the same time (Fig. 283).

FIG. 284.



To leap *depth*, take a position on the edge of the platform, which may be a strong shelf, sliding upon a post or upright ladder, to which it can be firmly clamped. Bend the knees until they project over the toes, raising the heels, and resting on the fore part of the foot. During the depression of the lower limbs, extend the arms downward by the sides, the hands lightly closed, the column of the body inclined to the front but held

close and compact, as represented in Fig. 284. Then press lightly from the feet, and spring to the front with sufficient force only to bring the back clear of the edge of the platform; extend the arms forward, and descend easily.



### The Leaping-Pole.

The evolutions with the leaping-pole may almost be viewed as belonging to recreative, rather than systematized exercise, being essentially adapted for open-air practice. They may, however, be appropriately considered here, on account of their obvious connection with the subject of

FIG. 285.



FIG. 286.



leaping. Such exercises are valuable on account of their giving precision to the eye and hand, the power of calculating distance, and of rapidly determining the instant for executing a complicated movement with the presence of mind to perform it, in addition to the physical exercise of the run and leap, the balance, and the descent.

The leaping-pole should be made of ash, about an inch and three-quarters in diameter, and eight or ten feet long. It ought to be perfectly smooth, and shod with iron at its lower end.

To leap *width*, take a position one pace from the mark, with the pole held horizontally across the body, the arms bent, the butt of the pole directed slanting toward the front. The hands should grasp the pole about a foot apart, the right one in front, the palms being upward, the fingers and thumbs meeting, or with the palm of the right hand downward. Next step forward with the right foot to the edge of the mark, advance the butt of the pole to its utmost reach, and fix it in the ground without displacing the feet, or changing the grasp of the hands. (Fig. 285.) Then spring from the feet and pass by the left of the pole, the whole body

FIG. 287.



and lower limbs being held straight and extended in one line when crossing it. (Fig. 286). Descend gently, and as the feet meet the ground raise the pole to the horizontal position in which it was held at the beginning of the evolution.

To leap *height* with the pole, take a position a short distance from the barrier, the space left being in proportion to the altitude of the intended leap. Next step forward, advancing the pole to within a foot or two of the bar or string, spring from both feet, and clear the obstacle, passing to the left of the pole, and holding the body in the attitude represented in Fig. 287. After clearing the barrier quit the grasp of the pole, throwing it back to the starting-point, and descend lightly, facing the posts. This exercise, like the previous one, should always be immediately repeated, advancing the left foot, the left hand to the front, and the body of the leaper passing to the right of the pole. This repetition, here as elsewhere, in the exercises prescribed in this and the preceding chapter, should be scrupulously practiced in order to fully carry out the great principle which should underlie all educational gymnastics of constantly striving to secure for the two component halves of the body an equal and symmetrical development.

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## CHAPTER IV.

# RECREATIVE EXERCISE, OR SPORTS AND PASTIMES.

A PROMINENT and distinguishing characteristic of recreative exercise is, that whilst all the other forms of physical education are to a certain extent clothed with the obnoxious quality of being *lessons* which must be learned, the pastimes treated of in this chapter are not in any sense unwelcome tasks, but pleasures to be enjoyed as rewards for duty diligently performed, and intellectual or corporeal labor faithfully accomplished. As already intimated, this intense gratification has an important influence in aiding the mere physical effects of exercise, and so powerful do we find it as a promoter of health that many pastimes, in themselves less beneficial than analogous gymnastic exercises, are thus rendered in their total effect far more advantageous to the well-being of the human organism.

A part of the benefit derived from sports of various kinds is doubtless due to the freedom from all restraint with which they are practiced, and this fact obviously interferes with the attempt to impose any strict hygienic rules upon indulging in pastimes. Just as the play of a frisky kitten, or an unbroken colt, expressive as it is of the natural desire for an infinite variety of muscular exercise, owes a portion of its beauty, its pleasure, and its real usefulness, to its spontaneous and untrammelled character, so do some of our best pastimes depend for their chief charm upon this fascinating attribute of *unchecked liberty*. Still experience has proved that to get the most "fun" for all the participants out of a game, regulations must be adopted and enforced, and there are few sports in which certain slight modifications are not more beneficial to health, and less open to objection from a sanitary point of view. To point out these favorable conditions, and indicate as far as our very limited space in this chapter will permit, some of the evils to be avoided, and some of the safeguards which can be easily thrown around the dangerous portions of various popular pastimes, without interfering too much with the freedom which so conduces to their healthfulness, is an important part of our present purpose.

### Rowing.

Among delightful summer pastimes, rowing certainly holds a very prominent if not a preëminent place. The pleasurable sensation of rapid and yet comparatively effortless movement, more agreeably analogous to the flight of a bird through the air than any other form of human progression, has for nearly all of us a peculiar and boundless fascination. Listen to what our own inimitable Dr. Holmes has to say in his charming way upon this interesting topic, when speaking as the Autocrat of the Breakfast Table: "Our boat is something of the shape of a pickerel as you look down upon his back, he lying in the sunshine just where the sharp edge of the water cuts in among the lily-pads. It is a kind of giant *pod*, as one may say—tight everywhere, except in a little place at the middle where you sit. Its length is from seven to ten yards, and as it is only from sixteen to thirty inches wide in its broadest part, you understand why you want those "outriggers," or projecting iron frames, with the rowlocks in which the oars play. My rowlocks are five feet apart—double the greatest width of the boat.

"Here you are, then, afloat with a body a rod and a half long, with arms or wings as you may choose to call them, stretching more than twenty feet from tip to tip; every volition of yours extending as perfectly into them as if your spinal-cord ran down the centre strip of your boat, and the nerves of your arms tingled as far as the broad blades of your oars—oars of spruce, balanced, leathured, and ringed, under your own special direction. This in sober earnest is the nearest approach to flying that



man has ever made, or perhaps ever will make. As the hawk sails without flapping his pinions, so you drift with the tide when you will in the most luxurious form of locomotion indulged to an embodied spirit. But if your blood wants rousing, turn round that stake in the river, which you see a mile from here, and when you come back in sixteen minutes (if you do, for we are old boys, and not champion scullers, you remember); then say if you begin to feel a little warmed up or not. You can row easily and gently all day, and you can row yourself blind and black in the face in ten minutes, just as you like. It has long been agreed that there is no way a man can accomplish so much labor with his muscles as in rowing. It is in the boat, then, that man finds the largest extension of his volitional and muscular existence; and yet he may tax both of them so slightly in that most delicious of exercises that he shall mentally write his sermon, or his poem, or recall the remarks he has made in company, and put them in form for the public, as well as in his easy chair.

"I dare not publicly name the rare joys, the infinite delights, that intoxicate me on some sweet June morning when the river and bay are as smooth as a sheet of beryl-green silk, and I run along ripping it up with my knife-edged shell of a boat, the rent closing after me like those wounds of angels which Milton tells of, but the seam still shining for many a long rood behind me. To lie still over the flats, and, when the waters are shallow, to see the crabs crawling and the sculpins gliding busily and silently beneath the boat; to rustle in through the long, harsh grass that leads up some tranquil creek; to take shelter from the sunbeams under one of the thousand-footed bridges, and look down its interminable colonnades, crusted with green and oozy growths, studded with minute barnacles, and belted with rings of dark mussels; whilst overhead streams and thunders that other river whose every wave is a human soul flowing to eternity, as the river below flows to the ocean—lying there moored unseen in loneliness so profound, that the columns of Tadmor in the Desert could not seem more remote from life—the cool breeze on one's forehead, the stream whispering against the half sunken pillars—why should I tell of these things, that I should live to see my beloved haunts invaded, and the waves blackened with boats as with a swarm of water-beetles? 'What a city of idiots we must be (thus speaks a Bostonian of aesthetic Boston), not to have covered this glorious bay with gondolas and wherries, as we have just learned to cover the ice in winter with skaters.'"

All modern racing-boats, and many of those better-class pleasure-boats, are now built with outriggers, because this mode of construction allows of so much more power being obtained by the oars with a narrower body to the vessel. The rower in the modern outrigger sits nearly in the middle of the boat, that is to say, about on that part which is one-third of the length of the thwart from the side opposite to his rowlock, where his mat or pad is firmly tied. Upon the front edge of this he sits, bend-



*THE WRESTLERS—A Famous Greek Statue.*





ing his knees, which are held about an inch apart, and placing his feet with the heels close together firmly against the stretcher, exactly in front of the middle of his body. Thus he sits square to his work, and will be sure to swing backward and forward exactly in a line with the boat's keel, or parallel to it. If his feet are nearer the side of the boat than they ought to be, he will swing toward the middle, or row into the boat, as it called. On the contrary, if the feet are too near the middle line, he will row out of the boat, as oarsmen technically phrase it. Both of these are bad faults, and cause the vessel to rock and roll considerably. The stretcher should be adjusted at such a convenient length that in the stroke the oar should just clear the knees, and the strap, when one is used, should be buckled to the inside foot, which is the one upon which most strain falls in feathering the oars. The thwart upon which the oarsman is seated should be high enough to give him a good command over the oars, and yet low enough to let him get them well over his knees.

The action of rowing is made up of two chief movements, the stroke and the feather. The stroke is made by pulling the oar supported in the rowlock through the water with the blade at right angles to the fluid traversed, so as to secure the greatest amount of resistance. In feathering, the oar is revolved upon its own axis at the conclusion of the stroke by turning the wrists, and thereby bringing the blade into a plane parallel with that of the surface of the water. The term is also often made to include the whole process of carrying back the oar in that same position, and commencing another stroke, as the oar is then technically spoken of as on the feather. This great accomplishment of rowers can be best acquired by the learner carefully watching and imitating masters of the art, as descriptions, however elaborate, are of little use.

The three main principles upon which success in rowing depends are, first, the keeping of perfect time; second, the putting in of the oar exactly at right angles to the surface of the water; and thirdly, rowing the stroke right out with the legs brought well into use. With reference to time a beginner is advised never to remove his eyes from the shoulders of the man in front of him, following his every motion, and making sure that if the time is wrong he will at all events not be to blame. He should be careful not to hurry the body forward, under the impression that he may otherwise be late, for this only makes the boat roll, and nothing demoralizes a crew more than that. Quick recovery after a stroke, and the free use of the legs, the moment the oar gets into the water, are important agents in the acquisition of that inspiring "lift" which is so desirable in boat-racing. A well-coached crew will, when rowing, especially when making "a practice spurt," such as is beautifully depicted in the illustration opposite page 899, cause the boat to appear as if it jumped out of water at the beginning of each stroke. The value of all work done in front of the rowlocks, that is to say, before the blade of the oar is brought

opposite to the oarsman's body, is exceedingly great. As regards the oar itself, it ought to be brought straight home to the chest, the knuckles touching the body just below the end of the breast-bone, because in this way every inch of water is made use of. When the stroke is ended, the hands should be dropped straight down, turned over and shot out again along the legs, and the body should follow without the least pause. If this rule is not attended to, the oar will be feathered under water, which will have a tendency to bury the boat too deep, recovery will be impeded, and the next oar is apt to be interfered with. To effect a quick recovery the back should be held perfectly straight, care taken that the knees are not dropped too low, and the straps not used too much, a light touch being all that is required. It is better to employ the force of the abdominal muscles, rather than the boat itself, of which the strap is a part. The body should be swung evenly forward from the hips, not with a jerk or plunge, or with greater rapidity at one time than another, but freely and easily without seeming as if the hip-joint worked with any stiffness about it.

The beginner should be exceedingly careful to get the oar in square, because if it goes into the water obliquely it will be very apt to descend too deep, and the boat will be caused to roll. The rule is to have the blade of the oar just covered with water and no more. Deep rowing not only makes the boat roll, but causes unnecessary fatigue, and is highly ungraceful. On the other hand, if the oar is not put in deep enough, an insufficient amount of work is done, and also a splash is caused which inconveniences the other oarsmen. In swinging backward and forward, the pupil should be taught to do so straight between the knees. Many otherwise good rowers screw across the boat, and thereby not only make it unsteady, and so spoil the pace, but also damage the appearance of the crew. Feathering under water is a common fault in rowing, and consists in commencing to feather before the oar is entirely above the surface. It is not likely to occur if the stroke is well rowed out and the hands brought fully up to the body before the next effort is commenced.

The principal dangers of violent rowing, and its preliminary training, are the production of hernia or rupture, which may be foreseen by a careful medical examination, and study of the family history; dilatation of the heart, which indicates its imminence by discomfort in the left side and breathlessness on slight exertion; hemorrhoids or piles, the prevention and treatment of which have been already discussed on page 550; varicose veins in the legs, which may often be avoided by attention to the bowels, and cured by an elastic stocking; and dilatation of the air vesicles of the lungs, producing a form of asthma, which has also been considered in a previous section. Blisters on the hands are very annoying to oarsmen, and may necessitate entire stoppage of the rowing, so that many a promised week's enjoyment has been cut short by this

effect of a first day's effort. To prevent blisters, keep the hands dry by wiping the perspiration off them frequently with a handkerchief slightly dusted with finely-pulverized oxide of zinc, French chalk, or violet powder. It is also important to see that the handle of the oar is smooth and kept dry, and to hold it firmly in the hand, all feathering being done by a motion of the wrist and elbow. If a blister threatens, stop rowing for an hour, wash the hands with soap and water, rub the spot with vinegar, and then with alcohol or whisky, drying the skin between each fluid application.

### Swimming.

The chances of being upset whilst rowing and having perhaps to depend for one's life to the swimmer's art, are so great that every wise man will learn to swim before he trusts himself in any kind of a vessel upon deep water. In fact, so many accidents always have and always will occur in navigation, that every human being ought to acquire the art of swimming as early in life as possible.

Observation of the finny tribes no doubt gave man the first clue to this accomplishment, and we find that savages are at least as proficient in swimming as are the inhabitants of more civilized countries. The ignorant South Sea Islanders who allowed a French sailor to drown because they could not believe that a grown-up man did not know how to support himself in the water, were quite as much to be pitied as blamed for their murderous stupidity. Necessity is in general the immediate motive-power of human activity, and long ere man knew how to construct boats and bridges, he was urged by the need of crossing deep waters to try and to practice swimming. In our own times, some of the most astonishing feats in the art of swimming have been performed. Lord Byron swam across the Hellespont, Clias across the Lake of Geneva, and the late Captain Webb carried out the wonderful achievement of swimming across the English Channel. Several other persons, both men and women, have of late given very foolhardy proofs of their ability in the art of swimming.

Swimming exercises are both invigorating and hardening, and of great value in the preservation of health if used in moderation, but they call forth such extensive muscular action, and throw such a great strain on other organs besides the muscles, that their effects, joined to those of the cold water, tax to the utmost the forces of many persons, even if not indulged in for more than five or ten minutes at a time.

In many places and seasons of the year natural obstacles interfere with the acquisition of the art of swimming, but something may be done to prepare a pupil on dry land for any unexpected plunge into the water. The Swiss method, largely adopted in France, is to place the learner upon a low folding stool, in the position represented in Fig. 288. The arms are to be flexed at the elbows, the open hands brought in con-



tact with each other just beneath the chin, and the legs somewhat bent, so as to approximate the heels to the lower part of the back. At the word "one," which the pupil should count after the instructor, the arms and the lower limbs should be quickly and forcibly stretched out, the hands held close together, with the palms in a horizontal plane, facing down-

FIG. 288.



FIG. 289.



ward, and the feet separated some fifteen or eighteen inches (Fig. 289). At the word "two," the knees are to be approximated, the legs still held extended, and the hands separated about six inches, the palms being directed more outward, though still somewhat downward (Fig. 290). Lastly, at the word "three," describe with each hand a quadrant of a circle, striking somewhat downward, and still more backward, until the posture shown in Fig. 291 is attained. At the same time the heels are to be drawn up, and at the conclusion of the effort to strike out, the hands

FIG. 290.



FIG. 291.



are to be restored to the first position, shooting them straight forward again in the line of the supposed swimmer's movement in the water, in order to interfere as little as possible with the onward progress through that fluid.

The first essay at real swimming may be facilitated by the use of the swimming-belt, or by securing the aid of a friend to support the learner under the body, or by two fingers under the chin. Most people, however, who have practiced enough to gain familiarity with the required movements as above directed, will be able to acquire the art without help. At first the attempt should be made in rather shallow water, and a still inlet or little bay of the sea has a great advantage, in that salt-water buoys up the body much more than fresh. A good preparatory exercise is to rest the hands on the bottom, where it is just far enough below the

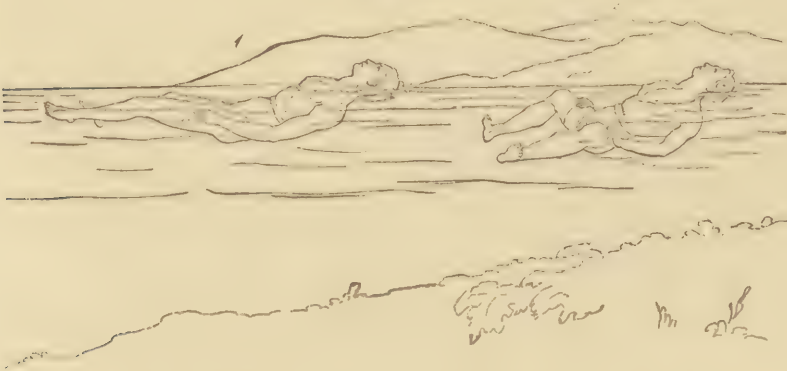
surface to allow the shoulders to remain uncovered, and then perform the leg movements as indicated in Fig. 288. After a little confidence is thus gained, let the learner wade out a short distance further until the waist is covered, and then stooping forward quietly perform the combined arm and leg motions as before directed, keeping the body at the right inclina-

FIG. 292.



tion, and bending the head well backward, exactly as shown in the accompanying illustration (Fig. 292). At the first few trials, some friend who is quite at home in the water should be close by to stretch forth a helping hand and support the pupil the moment such aid becomes necessary. It

FIG. 293.



is advisable for the learner to continue counting until he has gained some skill in performing the movements under water. As soon as he can do this, and thereby sustain himself whilst propelling the body forward a little, the art has been learned, and all that is requisite is the gaining of greater skill by practice. The mistakes which retard the attainment of the

art of swimming are too rapid movements; trying to float high up on the surface of the water, instead of keeping the body at the inclination shown by the figure; spreading the fingers instead of keeping them close together; and moving the arms too deep in the water, or else quite out of it, instead of about four inches below the surface.

After having acquired some skill in swimming forward, it is easy to learn how to support one's self in a nearly upright position by making slight but quick downward motions with the feet, constituting treading water, balancing the body at the same time by gentle movements of the hands. This constitutes an agreeable transition to swimming on the back (Fig. 293). In this form the head is bent backward, the chest arched forward, and the swimming movements are chiefly performed by rapid and forcible

FIG. 294.



stretchings out of the lower limbs. At first the beginner may aid himself by supporting himself on his back in shallow water with the hands resting on the bottom, or by slight movements of the arms.

When once this much of the art is acquired, the other varieties, such as swimming on the side, as shown in Fig. 294, are easily attained. These modifications are very valuable as enabling an expert swimmer to rest himself by varying the groups of muscles brought into play, and also as affording the power of dispensing with the movement of one or two limbs, should he be attacked with cramp.

In shallow bathing-places there is neither necessity nor opportunity for plunging into the water, but in cases of accident it is sometimes of the greatest importance to be able to leap into deep water calmly and courageously. The general rules to be observed when plunging in the depths of a river or pool are, first to take a deep breath before leaping; second, to offer the smallest possible surface, such as the feet or the hands, for resistance to the fluid. If a broad part of the body, such as the back or chest, strike against the surface of the water when plunging down from a considerable height it will cause severe pain, and may even have fatal consequences. At first the plunge ought to be made from a small

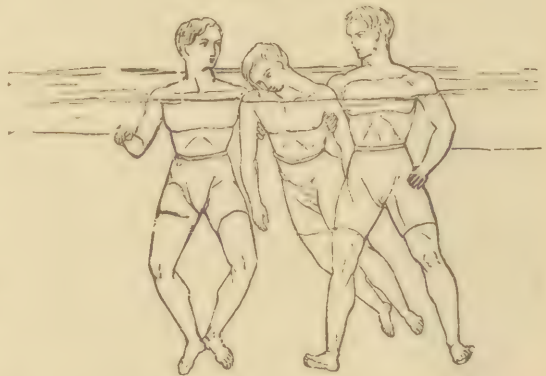


elevation only, in order that the learner may gradually accustom himself to self-possession underneath.

The leap down into the water with the feet foremost is performed with the feet and legs stretched out, the heels held closely together, so as not to separate when touching the water, the whole body retained in an upright attitude, with the hands and arms stretched out and kept close to the sides. When once submerged, the swimming movements ought to be immediately commenced, in order to rise to the surface as promptly as possible.

In the deep plunge headforemost, commonly called taking a "header," the swimmer stretches out his arms, bends his knees, and leans forward, flexing the body at the hips. The palms of the hands should be joined together over the head, in order to form a kind of cutwater for it and the rest of the body. When the pupil has bent so far forward that he is just on the point of falling, he should make a good start by springing with both feet, and immediately afterward throwing up the legs and stretching the back. As soon as the body is fully immersed the neck and spine should be bent backward, in order to change the direction of the body, and so bring the head above the surface.

FIG. 295.



When cramp occurs during swimming, the best plan is to turn on the back or tread water, keeping one's self afloat by paddling with one hand, whilst the other is used to rub or press the affected part. Two swimmers treading water can efficiently aid an exhausted or drowning person by supporting him, one under each arm, and carrying him along with his head above water and the body and limbs stretched out motionless. For other methods of rescuing sufferers from bathing accidents, and for the means of resuscitating those apparently drowned, consult page 99, in the section on water.

### Skating.

This is an accomplishment which should be picked up by every one who intends ever to learn it in youthful years when the distance to be tumbled is not great and the downfall of dignity is unimportant. A youngster in his teens, or even younger, seldom finds the task difficult, and the motion once acquired is as easy as it is far more

pleasurable and graceful than walking upon dry land. But at first it must be confessed that the movements are anything but natural and easy, and in fact few creatures look more awkward or helpless than a beginner upon skates. When such a tyro straightens himself up after first putting on a pair of skates, what horrifies him most is the rapidity with which a skate-wearing foot once started, makes off away from its owner. Especially does this perversity manifest itself if the errant pedal extremities can contrive to get in advance of the centre of gravity, and by flying up into the air horizontalize the would-be skater's perpendicularity in one of

FIG. 296.



those terrible falls on the back of the head which the subject of them finds it so hard to smile over in sympathy with the roars of laughter drawn from amused bystanders. The best way to avoid these severe falls is to commence humbly and not to disdain the welcome support of a friend's arm, such as Sam Weller's was temporarily to the agonized Mr. Winkle in the immortal *Pickwick Papers*, during the first half-hour of the lesson. In the beginning, the most important points to be acquired are to turn out the toes, to keep the centre of gravity always in front of and on the inner side of the feet, to allow each foot to complete its stride before the next one is commenced, and above all to keep the ankles stiff and firm.

The whole art of skating depends upon a practical knowledge of the laws of gravity or what is commonly called the balance. Just as a boy's hoop will roll along firmly erect whilst in rapid rotation, yet begin to vibrate from right to left, and, finally losing its balance, fall sideways as its motion grows slower, so will the balance of a skater on the thin edge of his skate be perfectly secure whilst he skims quickly along, but tottering or entirely lost if he neglects to keep up the rapidity of his movement.

Yet difficult as it seems at first, courage, confidence in the possibility of succeeding, fortitude in bearing hard knocks, and resolution not to be beaten will in a very few hours accomplish wonders in the way of learning to skate. If the novice will strive earnestly to keep his head up and his hands down, turn his toes well out and make long, clear, firm strokes with each of his feet, he will soon master the perplexing mysteries of the inside edge (Fig. 296), and after that has been overcome will find, like the juvenile geometer who has safely crossed the *pons asinorum*, that his greatest obstacle has been surmounted. As soon as he can get along at all without falling, the pains and griefs which attend the early education of a

skater are forgotten in the ease and rapidity of movement speedily attained by practice.

Skating on the outside edge (Fig. 297) is much more difficult than it appears at first sight, for the reason that a complete change of the posture of the body as well as of the position of the foot is necessary in order to bring the centre of gravity from its natural location between the feet to a point outside of that foot which rests on the ice. The safest and simplest method of gaining this movement is to learn first the ordinary *forward roll*, in which both feet are kept continuously on the ice whilst the skater advances in a serpentine course. When perfect in this, begin gradually to shift the weight of the body from the foot which is doing the inside edge to the other, and then, after a while raise the foot which is doing the inside, altogether off the ice at first, for an instant or so at a time only, putting it down when there is any danger of falling. By thus elevating on each occasion for a longer space the inside edge skate, the novice will learn to use the other with more and more confidence, until at length whole strokes can be completed on the outside edge alone. He who has once fairly mastered the outside edge, is thereby prepared for the study of the figures properly so called—of these the “8” and the “3” being among the most interesting and graceful.

Although the muscular movement given in the practice of skating is very valuable, and especially so because resorted to at a time of year when many other forms of recreative exercise are inaccessible, the great danger of breaking through the ice renders exceeding caution in the time and place of indulging in this fascinating sport necessary. As a general rule, it is not safe to venture on ice which is less than one and a half inches thick, or upon thicker ice which has been long exposed to air having a temperature above  $32^{\circ}$  on its upper surface, or of water, especially currents of water, similarly elevated much above the freezing-point. Every skater should be provided with a few yards of strong twine or small rope, in order to afford assistance in case of breaking through weak ice or plunging into an air-hole. Should apparent death from drowning occur in a skating accident, the treatment by artificial respiration, as directed on page 99, should be promptly and faithfully instituted, but more strenuous efforts should be made to restore by artificial warmth the animal heat so quickly lost by immersion in an icy fluid.

FIG. 297.





### Roller Skating.

Although this variety of skating exercise, which has recently become so wonderfully popular, does not involve any peril of drowning, it is by no means free from danger to health, or even to life. Besides the increased chance of bruises and broken bones from collisions in crowded rinks, the great risk to life is from pneumonia and other pulmonary affections, as a result of taking cold from exposure to draughts of air whilst the skin is moist with perspiration. The pleasurable excitement of skating, especially in agreeable society, is so great that few persons realize what vigorous muscular exertion they are making until after they sit down to rest; and,

FIG. 298



as already explained, such energetic contraction of the muscles, with its consequent increased production of heat, results in a profuse flow of perspiration, bathing the surface of the body, and rendering its partial cooling by a current of air extremely dangerous. This evil is aggravated by the fashion, only too prevalent, of keeping on hats, bonnets, and outer wraps, instead of changing the ordinary garments for lighter and looser clothing, as is or ought to be customary in all well-managed gymnasiums. Great care should be taken therefore to provide such external coverings as can be readily laid aside during active movement, and promptly reassumed on the cessation of vigorous muscular exertion. It is also advisable that persons who are heated and perspiring should not, although well protected by warm clothing, pass abruptly out into cold, and, particularly, cold night-air, which being inhaled over the heated mucous membrane is especially apt to set up the inflammatory action of bron-

chitis, pneumonia, and consumption, as already explained more fully on pages 511 and 515. In many skating-rinks the friction of the rollers, and so forth, fills the air with dust, which may have a very irritating effect upon the lungs, and combine with the other causes above mentioned to originate a long train of pulmonary disorders. The remedy for this danger to health is the institution of a system of thorough ventilation. This should be most emphatically insisted upon by the patrons of these establishments, which, when properly managed and wisely used, instead of being abused, confer a real benefit on the community by promoting a graceful, healthful, and exhilarating exercise.

### Dancing.

In all times and amongst all peoples, whether civilized, savage, or barbarous, dancing to music has taken a prominent place in the history of sports and pastimes. Like many other ancient customs, which civilization has modified and changed to suit altered circumstances and manners, dancing is now so different from what it was in former ages that it seems difficult to associate under the same title the method and object of the dance among the ancients with the contortions of a modern ballet-girl, or with the typical after-supper dance in a small over-crowded drawing-room. What a contrast there is between the dancing of days of yore, which was performed to the clash of cymbals and the clang of trumpets, in honor of some god, or king, or conqueror, and the modern private party dance in honor of nobody, and generally accompanied by no small amount of vexation to both host and guests. In former times dancing was performed out of doors in the fresh free air of heaven, but in our own day it is conducted in badly-ventilated rooms, loaded with excess of carbonic-acid gas, reeking with sickly perfumes, and foul with refuse products of combustion of coal gas and of human bodies.

Among many nations, especially those of Asia and Africa, dancing has a method and an object, being the unwritten history of some love-scene, heroic deed, or historical fact. Mr. Carter endeavors, with curious ingenuity, to trace a similar design in the ordinary quadrille. "If we analyze the different movements we will find," says he, "in the first figure opposite couples cross over, and return to their places; the ladies then engage in what is called ladies-châin, and setting to partners ends it. Here the idea is evidently a friendly advance on the part of the ladies towards better acquaintance. In the second figure the opposite couples advance and retire together, and after setting to partners move forward in the same manner. Here is evidently a further advance, as both couples act in harmony. In the third figure acquaintance has so far progressed that the four join hands and form a line. In the fourth figure the gentleman has come to know his *vis-a-vis* so well that he entrusts his lady partner to him, and is entrusted with a strange lady in exchange, by way of return-

ing the compliment. In the fifth figure all the couples in the set of the quadrille have improved their acquaintance to such an extent that they join hands and advance in good fellowship together. In the sixth figure, often called the flirtation figure, every gentleman trusts his neighbor so implicitly that he allows his lady partner to dance, or, as the name implies, to flirt, with every gentleman engaged in the quadrille. It is evident, therefore, that the various steps of the quadrille express a growth in intimacy between the different couples engaged in its performance. The 'Lancers' bear a like interpretation, and so do most contra-dances."

The effects of dancing vary according to the manner it is engaged in. The acrobatic performance called ballet-dancing, as seen upon the stage, requires an amount of preparatory care in training and education which lasts over many years. The acme of perfection consists in acquisition of the power of walking on the points of the toes. This necessitates an amount of extension or straightening out of the foot which can only be attained by the foot of a young person, and hence the practice must be commenced during the age of girlhood. In consequence of the excessive effort to retain the foot in this position, the muscles of the front of the thigh, and of the calf of the leg, assume enormous proportions. The foot, however, is rendered flat, and in ordinary walking the dancer's gait is apt to be ungainly. The muscular development of a professional dancer of celebrity, from the middle of the body downward, is in many cases extraordinary.

The influence of ordinary dancing upon health would no doubt be beneficial, were it not for the unhygienic surroundings which usually environ it. The amount of exercise obtained during a long waltz, provided it is not too long, no doubt does a great service to many a fashionable woman. Such an individual is often a stranger to proper walking exercise, and therefore a good dance, which compels her to breathe more deeply, assists the action of the liver, and causes the blood to circulate more freely through the heart and great vessels, may be just what she needs to promote her health. Were it not for the length of time the revolving movement is kept up in a prolonged waltz, affecting the nervous system injuriously, and on account of the insanitary environment at most dancing parties and balls, they would be excellent means of inducing the lazy and careless to take exercise enough to meet the hygienic requirements of their frames.

### Riding.

The use of saddle-leather, remarks Dr. Holmes, as a means of securing the proper and healthful amount of exercise, is in some respects even preferable to sole-leather. The principal objection to it is of a financial character. "Riding is good for those who are born with a silver-mounted bridle in their hand, and can ride as much and as often as they like, with-



out thinking all the time they hear that steady, grinding sound, as the horse's jaws triturate with calm lateral movement, of the bank bills and promises to pay upon which it is notorious that the profligate animal in question feeds day and night."

Riding exercise can be taken by almost every one with advantage throughout the whole period from childhood to old age. In youth the great benefit proceeds not only from the exercise, but also from the tendency which it has to the formation of a bold and fearless character, whilst at the same time it teaches a love and regard for the most noble of the lower animals. There is something wonderfully inspiring in rapid movement on the back of a galloping steed, and more than one great man has declared that his most brilliant ideas, as well as his most profound

FIG. 299.



thoughts, have come to him whilst on horseback. For delicate females, and for men who are suffering from the effects of sedentary life, high living, and other causes which produce congestion of the abdominal viscera, horseback riding sometimes proves invaluable, and there is no doubt that cure in some cases of incipient consumption has been largely due to a judicious employment of this form of exercise.

The general art of riding teaches us to so dispose of every part of the body that it can act upon the horse in every emergency, shows the effect of all the aids and modes of guiding him, and enables us to render him obedient to the slightest touch. By never suffering the ascendancy to be

transferred to the horse, by in general preventing him from making all his speed, but by exhausting him the sooner the more he exerts himself without permission, this method, when it can be fully carried out, bestows upon the rider perfect security.

To mount in the orthodox manner, let the pupil take the reins in the left hand, turn knuckles uppermost, dividing the reins with the middle finger, the off or right-hand rein passing between the middle and forefinger, and the near or left-hand rein being grasped by the middle and remaining fingers, whilst the thumb is clenched below where the rein passes out through the top of the grasp. Next place the left hand on the pommel, then the left foot in the stirrup, then the right hand on the cantle or croup of the saddle, and with a spring from the right foot, which is still on the ground, rise, and throwing the right leg over, settle in the seat. The body should be square and upright, not stiff, as though a poker had been swallowed, but playing from the hips with each motion of the steed; shoulders square, not slouching, left hand down close to the pommel, right hand holding the whip, butt uppermost, just in front of the right hip, ready either to use the lash if required, or to aid the left by drawing the reins through the grasp, or strengthening the pull when wanted (Fig. 299). During the first few walking lessons, the beginner had better sit without stirrups, in order to gain the proper grip with the knees, which is such an important acquisition. He should keep the toes in, the leg flat, the knee tight to the saddle, gripping it not with the back but with the side of the calf, as well as with the knee and lower portion of the thigh. When this grip is acquired, begin the use of the stirrups, taking care not to thrust the foot through to the instep, and to have the length of the stirrup-leathers properly adjusted, so as exactly to meet the ball of the foot when the knees are gripping the saddle to the best advantage. After a firm seat is secured, and the novice has gained some experience of more rapid movement in the easy gait of a canter, the more difficult pace of trotting may be tried. In trotting the rider should rise in his stirrups, that is, he should let his legs play slightly from the knee-joint in time with the trot, raising the body from the seat during one step, and lowering it gently to touch the saddle on the next. Slight motion suffices, and is facilitated, both for man and beast, if the horseman lets the small of his back also play a little as he ascends, bringing his chest forward, and so carrying the centre of gravity also forward for the instant, so as to let it hang more over the line of the knee and foot. This play of the body should be slight and gracefully done, never exaggerated into a stand-up and sit-down movement, between each step of the horse.

Among the difficult situations of horseback riding, that of rearing (Fig. 300) is perhaps the most dangerous, as it risks the animal's falling backward upon his rider. When a horse rises straight up in this way, the

rider must throw his own body forward, giving the animal all the bridle. The weight of the body will usually oblige him to come down, and the moment his fore feet are near the ground, and before they touch it, put both the spurs into the animal's sides as quickly and firmly as possible. Another mode of subduing a vicious animal whenever the rider is aware of his disposition to rear, is to have the reins separated, holding one in each hand. Then the instant the beast is about to rise, slack one hand and bend his head round with the other, keeping the rein low. This compels the horse to move a hind leg, and being thus thrown off his balance, he necessarily comes down with his fore feet. He should then be twisted round and round two or three times to convince him of the rider's superiority, and this so confuses and baffles him that he is commonly deterred from rearing for some time, at least to any dangerous height. To break vicious brutes of this perilous habit, it has been advised to leap from the horse and pull him over backward, but the risks of such a cure are so great that it should only be attempted by horsemen of unusual skill.

If a horse stumbles the rider must instantly throw his body backward, taking care that the rein is not too long, lest he fall over the tail of the animal as he recovers himself. The same position must be assumed when the horse kicks up behind, trying to throw the rider forward over his head. An effective punishment for this fault is to twist a horse round a few times, and if this is done on his weak or unprepared side, astonishment and confusion will ordinarily quell any further contention on his part.

When a horse either by shying or restiveness springs to one side, or turns short round, the rider's security depends upon his strict attention to the rules of not bearing heavily in the stirrups, keeping his legs near the horse, and always ready on these sudden and unexpected emergencies to lay hold with a firm grip of the knees, and lastly in yielding the body easily to the movements of the horse. Should, notwithstanding every care, the horseman be taken unawares and lose his seat, the most important things to do are, first to loosen the feet from the stirrups, and second to keep a tight hold of the reins, and so, if possible, prevent the animal from running away (Fig. 301). As an old huntsman used to say, "Any fool can fall from his horse, the thing is to know how to fall;" and yet the art is

FIG. 300.

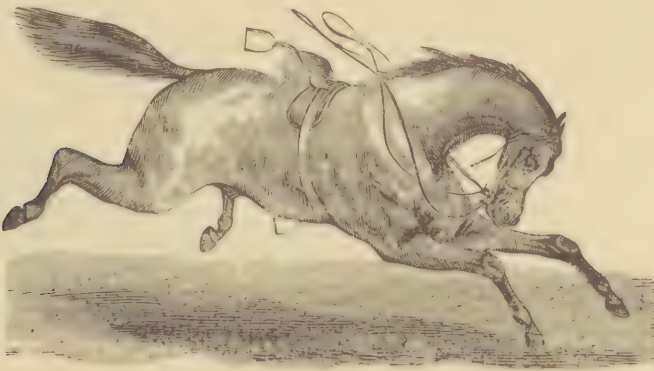




one in regard to which bought wisdom, gained at a fearful risk to life and limb, is the only kind which has much real value. Here and elsewhere, as so often insisted on in these pages, the ounce of prevention, in the form of unceasing watchfulness against the first threatenings of disaster, is far better than the troublesome and oft-inefficient pound of cure.

Among the minor evils which arise from excessive horseback exercise may be mentioned the tendency of tall men to become knock-kneed, and of short men to grow bow-legged, from long-continued sitting upon a horse. Another injury is the occasional wasting of the adductor muscles of the thighs, attributed to overuse and pressure combined, which is

FIG. 301.



believed to be, at least in part, the cause of that shambling gait so noticeable in ostlers and stablemen. Owing to the fact that the left arm is actively exercised in holding the reins, whilst the right is allowed to hang loosely, long-continued riding in time causes a marked change in the shoulders. The left shoulder becomes higher than its fellow, and this is especially the case with girls and women, in whom it may bring about what is called growing-out of the shoulder. This is a prominence of one or the other shoulder, dependent on curvature of the spine from its natural upright position. The left arm, from its being advanced and exposed to wet and cold, in consequence of its position in holding the reins, is more apt to become rheumatic, and may thus be the starting-point of serious trouble. This ought to be prevented by the systematic employment of extra coverings for the exposed part. Lastly, the numerous fractures, dislocations, and other injuries, among which fracture of the clavicle or collar-bone is probably most common, must be treated, when they unfortunately occur during indulgence in horseback exercise, according to the principles laid down in a previous section on wounds and accidents, for which see page 630.

### Bicycling and Tricycling.

The bicycle has become a common means of travelling in all countries where the roadways are sufficiently good to permit its use. Besides its really practical qualities as a vehicle it affords one of the best methods of taking enjoyable and recreative exercise. It brings into use a large number of the muscles both of body and limbs, and tends to a harmonious development of both sides of the human frame. At the same time

FIG. 302.



it increases the lung-power and the action of the heart. The dangers which attend its use are most commonly those of an accidental nature, and are for the most part to be avoided by proper care. Persons who are in delicate health, and especially those who are subject to any weakness of the heart, should be careful to avoid too long or too rapid riding, as their strength may be overtaxed unconsciously in the pleasures of the moment. But with this caution in view, there are comparatively few constitutional or acquired physical weaknesses which may not be benefited by the admirable combination of muscular action and out-door life which the bicycle affords. Ladies may find in the moderate use of the tricycle a similar beneficial and enjoyable exercise, and the custom of tricycling is rapidly becoming established in popular favor.

### Out-Door Games.

The great variety of attractive or even fascinating out-door games which have been devised, possess the advantage of leading to active exercise in the open air, and are all therefore highly conducive to health.

According to the different natural ability, acquirements, or taste of an individual, will be the personal predilection for one or more of these pastimes, and, as a general rule, the one in which a man finds the most intense and satisfying pleasure, will be the one which proves most permanently beneficial to him. This is true for the reason already pointed out, that happiness is the best tonic and the most powerful stimulus which can be applied to the majority of mankind. Like all the other good gifts heaven has bestowed upon us, recreative exercise will only bless with its highest benefits those who practice it with a due amount of moderation and self-denial, constantly endeavoring to learn how to use, without abusing, this greatest and most agreeable means for the preservation of perfect health.

From a strictly hygienic point of view, the worst defect of most popular games is that they throw certain portions of the duty, which give only a partial growth, upon particular players. These participants, in consequence

FIG. 303.



FIG. 304.



of their bringing into use only certain groups of muscles, become the subjects of an unsymmetrical development, which sooner or later is apt to display its evil effect upon the entire organism.

The famous English game of cricket (Figs. 303 and 304) seems almost to have been devised to avoid this disadvantage, by giving each member a share of the more important parts of the exercise. It therefore offers not only the most healthful recreation to players, but presents to those who understand the game one of the most agreeable means of passing their leisure hours in the open air. It cannot be denied that the members



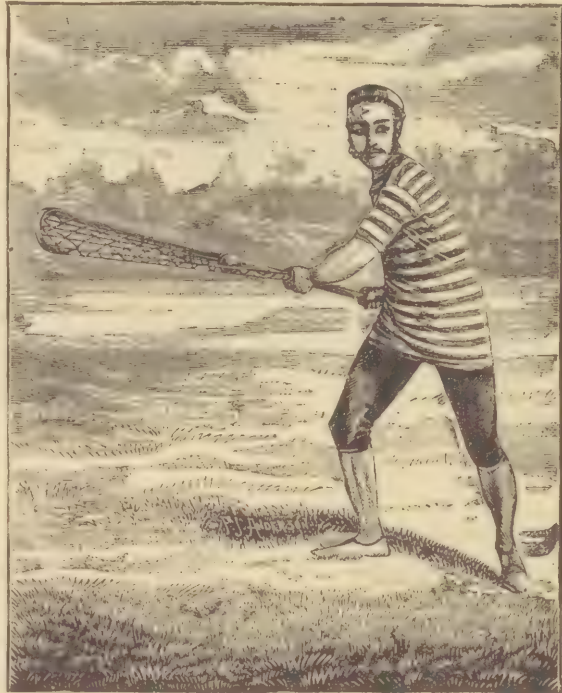
of a cricket club who in strength of arm, quickness of eye, and presence of mind, are so superior to their fellows as to render them most expert batsmen, are precisely the ones who have the largest share of the exercise which they least need for perfect development, and yet this disadvantage for those who are caught out on the first or second ball can in great measure be remedied by care in equalizing the players on each side. Thus not only may a greater amount of pleasure for all concerned be derived, but also the advantageous results to health obtainable from this noble pastime, are conferred with greater fairness upon each of the participants.

The dangers of fractured limbs and severe contusions should always be guarded against by means of the various protective articles of dress which are supplied for the purpose. To neglect such precautions, because they cause the player to present a supposed awkward or ungainly appearance, is about as silly, as everybody now-a-days can see it was, a hundred years ago, for men to refuse to save themselves from getting wet by carrying umbrellas because it appeared effeminate to thus protect themselves from the weather.

The Canadian national sport of Lacrosse is remarkable as one of the few games which have been really invented by barbarous tribes, and afterwards borrowed from them by civilized communities. There seems to be little

doubt that this game originated with the Indians inhabiting the prairies and plains of North America, and that it was practiced by them long before they had any intercourse with Europeans. When played by skilled contestants it excites general admiration, and few games constitute a better test for both fleetness of foot and general activity. In fact, there is scarcely any exercise which so completely combines all the primary requisites of a truly health-giving amusement—speed, skill, and

FIG. 305.



athletic training—all the elements of good physical condition being developed by it in a wonderful degree. The picturesque appearance of the field during a well-contested game of Lacrosse is another of its recommendations, and taking it all in all, it would be a matter of sincere congratulation if we could see this beautiful and healthful pastime substituted in popular favor for the American national game of base ball, with its frequently evil results of unilateral development and severe, or even fatal, injury.

FIG. 306.



LACROSSE.—THE FAMOUS NATIONAL GAME OF CANADA.







IN THE KITCHEN.

# HYGIENIC NURSING AND COOKING,

INCLUDING

The General Care of Children and the Hygienic Management of the Aged and Infirm.

TOGETHER WITH

THE PROPER CARE OF THE EYES, EARS, HAIR, TEETH, SKIN, HANDS, AND FEET; AN EXTENSIVE COLLECTION OF RECIPES FOR COOKING; RECIPES FOR CLEANING; RECIPES FOR THE TOILET, ETC; INTERESTING TABLES UPON HYGIENIC SUBJECTS; A FULL GLOSSARY OF MEDICAL TERMS, ETC.

WITH A COMPLETE TABLE OF THE

## DOSES AND PROPERTIES OF MEDICINES.

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BY

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# HYGIENIC COOKING.

## Diet in Its Relation to Health.

Good nutrition is the main source of steady work, good temper, and self-control. It is the all-important factor of a rapid and satisfactory convalescence; often it is the straw in the balance that determines the result of an acute illness—life or death. Some one has said that diet is the philosopher's stone, by which a man can be made lively or sad, good or bad, lazy or studious, long or short lived. This is certain: of all the important duties of the human organism, eating is one of the foremost, and the way we eat, with what we eat, will have much to do with our health and longevity; much to do with our power of resisting disease, and our ability to make a rapid convalescence from any illness that may unfortunately attack us.

Our stomachs are the mainsprings of life. They are the chemical laboratories wherein is generated life-force. The very first essential to good nutrition is to possess strong digestive organs, and for this reason the knowledge of how to care for them, how to use them without abuse, how to keep them from early decay, is the most valuable of all hygienic teachings. The digestive apparatus is as often abused, perhaps, by the quality or inferior method of preparation of our food as by errors in quantity.

Habits of rapid and imperfect mastication are fertile causes of dyspepsia, but not more so than is the prevalent ignorance in the preparation of food. American rapid eating is generally stated as a main factor of causation of the American disease—dyspepsia. Perhaps, if American bad cooking were improved, less would be heard of dyspepsia.

Those who have read carefully the earlier chapters of this work, readily understand that at all times it is necessary that the food on which we live should be of such a nature as to repair the waste of our bodies that is always going on. It must be of a certain kind, and in a sufficient quantity. During illness this waste goes on even to a greater extent than during health, and there is a lessened supply of strength coming in from food, air, and the exercise of the animal powers. There is enormous waste with far lessened repair process. Here it requires consummate skill and tact to strengthen digestion, to repair as rapidly as possible the undue waste, to bring back the patient safely to health.

Again, there is a great difference between providing food for one who grows better each day and for one who grows worse. The convalescent finds day by day renewed strength and a sharper appetite; the failing invalid finds each day a new difficulty, a capricious appetite, fastidious palate, weakening digestion. Here the cook or nurse will be tested to the utmost.

### **The Qualifications of a Cook.**

An old saying runs, "If fools never went to market, bad wares would not be sold." A woman, whether she goes to market herself or not, ought to be a judge of meats, fish, and fowl, to know stale from fresh fruits and vegetables, to have clear ideas of good flour, rice, sago, and the scores of things required in the culinary department. She ought to know all about kitchen utensils, the essential ones, and their quality. She should be familiar with the time required to cook different articles, and the full management of the fire. In short, kitchen and house work should be elevated from mere humdrum drudgery. They should be carried on with the exactness of science, and the refinement of art. There is great opportunity in this direction to give our daughters a training in a department of knowledge that may lessen, perhaps, their brilliancy in the parlor, but that will wield in the long run a more enduring and noble influence. Woman's influence over man is constant. She rocks the cradle of the nation. She brings forth intellectual and physical giants or pigmies. "To the average young man, who estimates a woman by the elegance and costliness of her attire, her skill in fingering the piano, her gracefulness of movement in the waltz or quadrille, the ready flow of tongue, or the size of her father's bank account, the idea of cultivating a knowledge of household duties seems superfluous. But when these accomplished creatures become wives, and are called upon to superintend domestic matters, especially those relating to the kitchen, it then becomes apparent that a most important part of their education has been neglected. To set a table properly, to be able to select and prepare the food to be placed on it, if such preparation is needed on her part, is something of which any woman has a right to be proud, and those who have acquired these arts bring to their husbands treasures more to be prized than much gold."

### **The Model Housewife.**

A woman of tact will have her dining-room the cheeriest room in the house. In that room she desires to have manufactured good bodies, strong minds and cheerful spirits. She will see to the comeliness of her dishes, the cleanliness of the linen, and the addition of bouquets or other artistic decorations, for well does she know that the road to the palate lies through the eye. There is inducement to tarry at an attractively-set

table, and a good housewife can so please her family by cleanliness, by savory cooking, cheer and comfort at the table, as to incline all to proper leisure in eating, and thus to the performance of an important duty toward their bodies. Housekeepers should bring the same interest and intelligence to bear in matters pertaining to the kitchen and dining-table as in the other important transactions of life. In all this there is science, but no mystery. It involves patience and understanding, and, when well done, it repays for trouble bestowed. A good cook rises to the dignity of an artist, and may rank with the chemist and with the physician.

### Utensils Required for Successful Kitchen-Work.

For the convenient and successful management of kitchen-work, various implements and utensils are necessary. The following is a useful reference-list of these articles, prepared by Helen Campbell:

#### Tinware.

One boiler for clothes, holding eight or ten gallons.  
Two dish pans, one large, one medium sized.  
One two-quart covered tin pail.  
One four-quart covered tin pail.  
Two thick tin, four-quart saucepans.  
Two two-quart saucepans.  
Four measures, from one gill to a quart, and broad and low, rather than high.  
Three tin scoops of different sizes for flour, sugar, etc.  
Two pint and two half-pint moulds for jellies.  
Two quart moulds.  
One skimmer with long handle.  
One large and one small dipper.  
Four bread pans, 10 x 4 x 4.  
Three jelly-cake tins.  
Six pie plates.  
Two long biscuit tins.  
One coffee pot.  
One colander.  
One large grater.  
One nutmeg grater.  
Two wire sieves, one ten inches across, the other four, and with tin sides.

One flour sifter.  
One fine jelly strainer.  
One frying basket.  
One Dover egg beater.  
One wire egg beater.  
One apple corer.  
One pancake turner.  
One set of spice boxes, or a spice caster.  
One pepper box.  
One flour dredger.  
One sugar dredger.  
One biscuit cutter.  
One potato cutter.  
A dozen muffin rings.  
Small tins for little cakes.  
One muffin pan.  
One double milk boiler, the inside boiler holding two quarts.  
One fish boiler, which can also be used for hams.  
One deep bread pan; a dish pan is good but must be kept for this.  
One steamer.  
One pudding boiler.  
One cake box.  
Six teaspoons.

#### Woodenware.

One bread board.  
One rolling pin.  
One meal board.  
One wash board.  
One lemon squeezer.  
One potato masher.  
Two large spoons.  
One small one.

Nest of wooden boxes for rice, tapioca, etc.  
Wooden pails for graham and cornmeal.  
Chopping tray.  
Water pail.  
Scrubbing pail.  
Wooden cover for flour barrel.  
One board for cutting bread.  
One partitioned knife box.



## Ironware.

|                                                                              |                                         |
|------------------------------------------------------------------------------|-----------------------------------------|
| One pair of scales.                                                          | One large meat fork.                    |
| One two-gallon pot with steamer to fit.                                      | One meat saw.                           |
| One three-gallon soup pot with close-fitting cover.                          | One cleaver.                            |
| One three-gallon porcelain-lined kettle, to be kept only for preserving.     | One griddle.                            |
| One four or six-quart kettle, for apple sauce, etc.                          | One wire broiler.                       |
| One tea kettle.                                                              | One toaster.                            |
| One large and one small frying pan.                                          | One waffle iron.                        |
| Two Russia or sheet-iron dripping pans, one large enough for a large turkey. | One can opener.                         |
| Two gem pans with deep cups.                                                 | Three pairs of common knives and forks. |
| Two long-handled spoons.                                                     | One small Scotch or frying kettle.      |
| Two spoons with shorter handles.                                             | One chopping knife.                     |
|                                                                              | One meat knife.                         |
|                                                                              | One bread knife.                        |
|                                                                              | One set of skewers.                     |
|                                                                              | Trussing needles.                       |

## Earthen and Stoneware.

|                                                           |                                                                                   |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------|
| Two large mixing bowls, holding eight or ten quarts each. | Two crocks holding two quarts each.                                               |
| One eight-quart lip bowl for cake.                        | One bean pot for baked beans.                                                     |
| Half a dozen quart bowls.                                 | One dozen Mason's jars for holding yeast, and many things used in a store closet. |
| Half a dozen pint bowls.                                  | Stone jugs for vinegar and molasses.                                              |
| Three or four deep plates for putting away cold food.     | Two or three large covered stone jars for pickles.                                |
| Six baking dishes of different sizes, round or oval.      | One deep one for bread.                                                           |
| Two quart blanc-mange moulds.                             | One earthen tea pot.                                                              |
| Two or three pitchers.                                    | One dozen pop-over cups.                                                          |
| Two stone crocks, holding a gallon each.                  | One dozen custard cups.                                                           |
|                                                           | Measuring cup.                                                                    |

## Miscellaneous.

|                                                                          |                                        |
|--------------------------------------------------------------------------|----------------------------------------|
| Scrubbing and blacking brushes.                                          | Patent irons.                          |
| Soap dish.                                                               | Tea strainer.                          |
| Knife board.                                                             | Bread toaster.                         |
| Vegetable cutters.                                                       | Corn grater.                           |
| Pastry brush.                                                            | Ice pick.                              |
| Egg basket.                                                              | Strainer cloth.                        |
| Market basket.                                                           | Funnel.                                |
| Broom.                                                                   | Dipper with holes in it.               |
| Brush.                                                                   | Fish fork with long handle.            |
| Dust pan.                                                                | Wooden fork.                           |
| Floor and sink cloths.                                                   | Oyster frying pan with inside drainer. |
| Whisk broom.                                                             | Sausage cutter.                        |
| Four roller towels.                                                      | Cork screw.                            |
| Twelve dish towels.                                                      | Meat pounder.                          |
| Dishes enough for setting servants' table, heavy stone china being best. | Coffee mill.                           |
| Patent cake beater.                                                      | Apple parer.                           |
| Cherry stoner.                                                           | Can opener.                            |
| Meat cutter for cutting meat very fine.                                  | Cream whipper.                         |
| Patent wine press.                                                       | Gravy strainer.                        |
| Patent jelly press.                                                      | Wire basket.                           |
|                                                                          | Corn popper.                           |

**Housekeeper's Table.**

As many families have no scales for weighing, a table of measures is given which can be used instead. Weighing is always best, but not always convenient. The cup used is the ordinary coffee or kitchen cup, holding half a pint. A set of tin measures, from a gill up to a quart, is very useful in all cooking operations :

One quart of sifted flour is one pound.

One pint of granulated sugar is one pound.

Two cups of butter packed are one pound.

One quart of butter is one pound.

One quart of Indian meal weighs one pound, two ounces.

One quart of powdered white sugar weighs one pound, one ounce.

One quart of the best brown sugar weighs one pound, two ounces.

Ten eggs are one pound.

Five cupfuls of sifted flour are one pound.

A wine-glassful is half a gill.

Eight even tablespoonfuls are a gill.

Four even saltspoonfuls make a teaspoonful.

A saltspoonful is a good measure of salt for all custards, puddings, blanc-manges, etc.

Use one teaspoonful of soda to a quart of flour.

Use two teaspoonfuls of soda to one of cream of tartar.

Use two heaping teaspoonfuls of baking powder to one quart of flour.

Use one cup of sweet or sour milk as wetting for one quart of flour.

Forty drops make one small teaspoonful.

**General Hints on the Selection of Foods.**

*Age* has an influence on the quality of meat. The flesh of young animals is more tender than that of old, yet experience shows that the younger is more resistant to the digestive powers. Veal and lamb tax digestion and dyspeptics more than beef and mutton. The tissues of young animals, moreover, are more gelatinous, less stimulating, and of less nutritive value. Beef is in perfection about the seventh year, wether mutton at the fourth, ewe mutton at two years.

*Sex* also has an influence on the quality of the meat, the female being more delicate and finely-grained. Castration takes away the strong flavor and improves meat for edible purposes. Meat is better in season. Mutton and beef are never actually out of season, yet when used in the early winter months the animal has had the advantage of abundance of fresh summer food. The best method of killing animals is by draining off the blood. There is a loss of nutriment, it is true, in this way, but it renders the meat more pleasant to the eye, easier to keep, and improves the flavor, and there is less danger of obtaining any blood disease the animal may have had.

Mutton is easier of digestion than beef. This may escape the notice of a well person, for such a one has digestive powers in excess of what is required for easy digestion of either, but in the dyspeptic a nice balance between comfort and distress may exist. With such a one the beef may rest somewhat heavily, while mutton may excite no discomfort. It is well to remember idiosyncrasies may exist, and that to some, mutton may act as a poison.

Pork is rich and trying to the stomach, and it is absolutely out of season in the summer time.

Cured meats are less digestible than the same meat fresh. Bacon is an exception to this rule. Venison is digestible, but too rich for some stomachs. Bone contains quite an amount of nutritive material. To extract it, the bones must be well crushed and boiled for a long time.

The white flesh fish are easier of digestion than the red flesh. Whiting, the chicken of the fish tribe, being the easiest digested of the white flesh: cod the hardest. Oysters are self-digestive when eaten raw. Cooking makes them less so. They make blood rapidly with far less stimulation than meat. They are peculiarly valuable for the aged, the intemperate and those who suffer from exhaustion, as after a severe hemorrhage, or chronic discharges of any kind.

Eggs are easier to digest when eaten slightly boiled, even more so than when used raw.

Good soup is a valuable article of diet. It has been said that to administer a well-made plate of soup is as important as to prescribe a pill.

Of the vegetable foods, the farinaceous or starchy are most nutritious. Bread to be digestible must be light. Macaroni and vermicelli, on account of their closeness of grain, are not quite as easy of digestion as bread. Oatmeal is a nutritious food, but does not agree with all persons; sometimes it causes acidity. Many a dyspeptic has been cured by giving up its frequent use. Barley is a strength-giving food not fully appreciated in this country. The Arabs give it the preference as a food for their horses. Rye is nearly as nutritive as wheat, and useful in costive cases. Corn is rich in fat, nourishing, and digestible when the fatty nature is not an objection. Rice is the food of a vast number of the human race; it is very rich in starch, but poor in nitrogen; it possesses an easily-digested starch granule. In cases of diarrhoeal affections it agrees better than any other kind of solid food. Arrowroot, sago, and tapioca, being pure starch, can be used only as an auxiliary to other foods. Buckwheat contains carbon in excess: it makes better cakes when it is mixed with wheat or rye flour. Beans and peas are nutritive; they should be cooked well, masticated thoroughly, and eaten with starchy food—not with much meat. Oleaginous seeds, like almonds, walnuts, Brazil nuts, etc., are highly nutritive, but like all articles permeated with fatty matter, are hard of digestion. Potatoes, when mealy, are easy of digestion; when close and watery, hard. Young potatoes being more watery, are therefore of more difficult digestion. Plants of the cabbage tribe are hard to digest. They contain much sulphur, thus giving rise to flatulency: they are wholesome and agreeable, however. We must not suppose we are never to use an article simply because it is comparatively hard to digest. Judgment must be used. It is well to remember that the stomach is made to do some work, and harm can come from over-petting of it. It is well to



use in our diet, now and then, something that has never seen fire ; hence the value of raw cabbage greens and salads.

Of the fruits, plums are the most likely to cause disorder of the bowels. Raw pears are easier to the stomach than raw apples. Cherries, like plums, easily cause diarrhœa. Serious consequences have followed the swallowing of the stones of cherries. Bananas, on account of the amount of nitrogen they contain, are quite nutritious.

Condiments are not strictly alimentary, but prove of service in more ways than one. First, they render food more tempting, and thereby increase the amount used. Second, they aid digestion. Third, they may correct injurious properties belonging to an article. Vinegar and pepper are used instinctively with those things hard to digest.

Coffee is the cup that cheers, but does not inebriate. An enthusiast exclaimed: "Breakfast without coffee is like a wedding without a bride." Coffee stimulates the brain gently, banishes somnolence, and aids digestion, strengthens one for the day's work, invigorating and cheering him. Used in moderation, and not too strong, no harm can come from its use. Tea should be used with the same moderation as coffee, and then, particularly if the black tea is selected, it cheers and exhilarates without doing any harm. Used in excess it is a fertile source of nervousness and dyspepsia, as well as of constipation.

### The Digestibility of Various Kinds of Food.

A table of the comparative digestibility of different articles of food is of interest as well as of practical value :

#### Meats.

EASY TO DIGEST.—Mutton, venison, hare, sweetbread, chicken, turkey, partridge, pheasant, grouse, beef tea, mutton broth, beef.

HARD TO DIGEST.—Pork, veal, goose, liver, heart, brain, lamb, duck, salt meat, sausage.

#### Fish.

EASY TO DIGEST.—Turbot, haddock, flounder, sole, fresh fish (generally), roasted oysters, trout, pike.

HARD TO DIGEST.—Mackerel, eels, salmon, herring, halibut, salt fish, lobster, crabs, mussels, cod.

#### Vegetables.

EASY TO DIGEST.—Asparagus, French beans, cauliflower, beets, potatoes, lettuce.

HARD TO DIGEST.—Artichoke, celery, spinach, cabbage.

#### Fruit, Etc.

EASY TO DIGEST.—Baked apples, oranges, grapes, strawberries, peaches, cocoa, coffee, black tea, sherry, claret.

HARD TO DIGEST.—Apples, currants, raspberries, apricots, pears, plums, cherries, pine apples, chocolate, pickles, porter.

**Time Required to Digest Certain Articles of Food.**

- It requires three hours to digest one pound of beef.
- It requires three and a half hours to digest one pound of cheese.
- It requires two hours to digest one pound of milk.
- It requires three hours to digest one pound of eggs.
- It requires four hours to digest one pound of veal.
- It requires four hours to digest one pound of fowls.
- It requires four hours to digest one pound of pork.
- It requires one hour to digest one pound of tripe.
- It requires three and a half hours to digest one pound of bread.
- It requires three and a half hours to digest one pound of potatoes, boiled.
- It requires two hours to digest one pound of potatoes, roasted.
- It requires four and a half hours to digest one pound of cabbage.
- It requires two and a half hours to digest one pound of beans.

**Comparative Digestibility of Animal and Vegetable Food.**

Pavy says: "Animal food being identical in composition with the structures to be built up and maintained, contains neither more nor less than what is required for the growth and renovation of the body. It might be assumed from this relation that nutrition upon a supply of animal food would be carried on in a more simple way than nutrition upon vegetable food, where no such identity is observable, and which contains various principles, such as lignin, cellulose, starch etc., which have no existence in the animal body. Nutrition, however, is not effected in this simple manner. With animal as well as with vegetable food, a transformation has to take place before absorption can occur. The nitrogenous alimentary principles of the vegetable agree in composition with those of the animal kingdom, and it has been ascertained by physiologists that all alike undergo metamorphosis under the influence of the digestive process into a certain product, which is characterized by the possession of properties, viz., those of great solubility and diffusibility, that especially adapt it for transmission by absorption from the alimentary canal into the blood-vessels, by which it is conveyed to organs that elaborate and convert it into the nitrogenous principles existing in and applied to the purposes of the system. Thus, we elaborate for ourselves the constituent nitrogenous principles of our bodies out of a certain product of digestion, instead of deriving them directly from our food, and this brings alimentation, as far as these principles are concerned, to the same position, whether upon animal or vegetable products. There is only this difference to be noted—that animal nitrogenous substances appear to be more easily digested than vegetable. With fats the same process occurs, whether they are of animal or vegetable origin; but, as with nitrogenous substances, it is believed that animal fats are more easy of digestion or preparation for absorption than vegetables. Although animal food certainly taxes the *stomach* more than the ordinary forms of vegetable food that we consume, as is well known by those who have weak digestive

power, yet, taking digestion and assimilation as a whole, a more complex process has to be gone through where vegetable food has to be dealt with.

Accordingly we notice that the digestive apparatus of the herbivora is developed upon a more extended scale than in the carnivora.

The difference, for instance, in the length of the intestinal canal is exceedingly marked, and as already mentioned, it is especially here where the digestion of the principles that preponderate in vegetable products occur. A portion of the large intestine, also, known as the cæcum, which is not developed in the carnivora to any particular extent, attains, in many of the herbivora, enormous dimensions, and it can scarcely be doubted that this is designed for affording some kind of extra assistance in the digestive process."

### Food Combinations.

It is generally known that too great a variety of foods eaten at a single meal is not favorable to the best digestion, but very few cooks pay much attention to the *proper combination* of foods. It stands to reason that foods should be studied in their relations to each other, as well as with respect to their nutritive qualities. A person can rise from the table feeling actually hungry, after eating in quantity a full meal. In such a case the articles eaten have not been of such a character as to supply the natural waste of the system.

In selecting foods for the table, one must take into consideration the habits of the individuals to be fed, and the ever-varying climatic conditions. The sedentary must be fed differently from laborers, who require a larger proportion of more nutritious foods. A combination of food that would be delightful in July or August, would be insufficient and distasteful in December. In cold and damp weather, warm food is better relished. The cook should use good judgment, considering the character of the eaters, and ever changing with the weather. She should know that certain kinds of foods are antagonistic to each other, that they will not digest well together, and that, with others, there is a sort of a kindred tie, which makes an agreeable combination. For example, sweet potatoes and tomatoes go well together, the one being sweet and nutritious, the other, acid and juicy. Dr. Susanna W. Dodds gives the following rules for food combinations:

1. Fruits and vegetables should not, as a rule, be eaten together.
2. Vegetables are best eaten at the noon-day meal, two or three varieties being quite sufficient. Tomatoes do well with vegetables, grains, or meats; but they should not, as a rule, be eaten with fruits.
3. The Irish potato is an exception among vegetables; it seldom quarrels with anything.
4. Fruits and cereals are particularly suited to the morning and evening meals, and very little other food is required.



5. A supper is best made of bread and fruit only, taken in limited quantities, and at an early hour.

6. Fruits, if eaten raw, should be ripe and of good quality, and persons with feeble stomachs digest them better at the beginning of the meal; this is particularly true when warm foods make a part of the repast.

7. Some persons cannot digest certain kinds of raw fruits for supper, or late in the day; let them take these on sitting down to the breakfast table.

8. Meat should be used at the noon-day meal, and in cold weather rather than warm.

9. The grains digest well with all other foods, though some persons cannot eat them in the form of mushes. They should always be well cooked.

10. Persons with feeble digestion should, as a rule, confine themselves to a single kind of fruit at a meal; they can make the changes from one meal to another.

11. Those who find it difficult to digest vegetables, should not attempt more than one kind at a given meal, until the digestion is improved. Often it is best to leave them off entirely for a time.

12. In selecting vegetables for a single meal, do not, if there are several varieties, have *all* of them of the watery kinds, as cabbage, asparagus, white turnips, etc.; nor all of the dryer sorts, as baked beans, winter squashes, sweet potatoes, etc., but blend the more and less nutritive kinds in a judicious manner.

13. If you have for dinner a thin vegetable soup, follow with something more substantial, as baked beans, baked potatoes, or corn bread; but if you have bean or split-pea soup, let the other vegetables be of a kind less hearty.

14. On very cold days, have a warm dinner of good nutritious articles; select mainly solid foods with grains, rather than thin soups and watery vegetables.

15. On a warm day make the breakfast largely of fruits, with a moderate supply of cereals; the dinner of young vegetables, or fruits, a dish of grains, and a little bread. Eat lightly, and you will not suffer so much from the heat.

16. In very cold weather take the chill off your stewed fruit, fruit pies, or other dishes, before serving them. Pastries, if used, are best at the mid-day meal, and so are puddings.

17. Never have too great a variety at a single meal, have few dishes, well prepared, and make the changes from one meal to another.

18. If one meal falls below the average as to quality or variety, see that the next is fully up to the mark.

### The Effects of Cooking upon Food.

What purposes are fulfilled, it may be asked, by cooking? Our food is rendered more pleasing to the eye, agreeable to the palate, and digestible by the stomach. Cooking lessens cohesion, coagulates the albumen of meats, solidifies the fibrin, gelatinizes fibrous and connective tissues; it softens the consistence of vegetables, and so enables them to be more readily masticated, loosens their intercellular structure, and thus facilitates the penetration of digestive juices into their substances, and it causes the starch granule to swell and burst, allowing the digestive fluids to come in contact with the central part. Then the warmth imparted to food by the process of cooking aids the digestive action of the stomach, and also exerts a reviving effect upon the system when it is fatigued, or has been exposed to cold. The modes of cooking in common use are: *Boiling, roasting, broiling, baking, frying, and stewing.*

### Boiling.

If the object to be attained is the extraction of the virtue of meat into the surrounding liquid, as in making broths and soups, the article should be cut up finely and placed in cold water. After soaking for a short time, heat should be applied, and the temperature slowly raised. Thus treated, the principles of the meat pass out into the surrounding liquid, and as this gains in flavor and nutritive properties, the meat becomes impoverished. If it is desired to retain the flavor and nutritive properties of the meat, an opposite process must be adopted by plunging the meat suddenly into boiling water and briskly maintaining the boiling process for a few moments. This coagulates the albuminous matter upon the surface and forms an almost impermeable external layer, which keeps the juices from escaping from the substance of the meat. After this the boiling should not be continued, a temperature of about 165° F. being all that is required, and this should be continued until the cooking is done. This will give a juicy and tender central meat, possessing all the properties of nutritiveness and digestibility. The usual fault committed in boiling meat is in keeping up too high a temperature by which the muscular tissue is made to shrink and become hard and indigestible. Fish is rendered firm in proportion to the hardness of the water in which it is boiled; hence by boiling it in sea-water or salt-water its flesh is firmer and more highly flavored.

Potatoes should be boiled in their skins to retain their soluble constituents. This object is still further attained by adding a little salt to the water. By steaming, the object is still further secured. One objection to boiled food is that it is more insipid than food cooked in other ways. This loss of flavor makes it less tempting to the palate, but it sits more easily on a delicate stomach.

IN BOILING USE COLD WATER FOR :

1. All kinds of salt meat, salt fish, some fresh fish, and root vegetables, except very young potatoes.
2. Such green vegetables as artichokes, cabbage, beans, peas, asparagus, seakale, and broccoli.

IN BOILING USE BOILING WATER FOR :

1. Almost all green vegetables. (See exceptions opposite.)
2. Shell-fish, herrings, soles, skate, mackerel, and all crimped fish.
3. All kinds of puddings, whether of paste, batter, or rice, except plain boiled rice.

When meat is boiled enough it looks plump and shrinks away from the bone. -

When vegetables are done enough they sink to the bottom of the water.

When fish is done the eye-balls fall out, and the fins are easy to pull away.

Time Required for Boiling.

*(Much depends upon the freshness and age of the articles.)*

|                                                              |                     |
|--------------------------------------------------------------|---------------------|
| For each pound of corned beef . . . . .                      | 30 minutes.         |
| For each pound of beef . . . . .                             | 15 to 30 minutes.   |
| For each pound of veal . . . . .                             | 15 to 20 minutes.   |
| For shoulder of mutton weighing 5 to 6 pounds . . . . .      | 1 hour.             |
| For leg of mutton, for each pound . . . . .                  | 20 minutes.         |
| For leg of lamb . . . . .                                    | 15 minutes.         |
| For tongue of beef . . . . .                                 | 4 hours.            |
| For ham, for each pound . . . . .                            | $\frac{1}{2}$ hour. |
| For turkey, for each pound . . . . .                         | 20 minutes.         |
| For brill . . . . .                                          | 10 to 15 minutes.   |
| For turbot (4 to 5 pounds) . . . . .                         | 20 to 30 minutes.   |
| For haddock . . . . .                                        | 15 to 30 minutes.   |
| For mackerel . . . . .                                       | 20 to 30 minutes.   |
| For salmon, to each pound . . . . .                          | 8 minutes.          |
| For skate . . . . .                                          | 30 to 60 minutes.   |
| For whiting . . . . .                                        | 5 to 15 minutes.    |
| For cod (only simmer) . . . . .                              | 1 hour.             |
| For fish in general, to each pound . . . . .                 | 10 minutes.         |
| For carrots . . . . .                                        | 1 hour.             |
| For turnips, parsnips, cabbage, seakale . . . . .            | 1 hour.             |
| For cauliflower, onions, beans (young) . . . . .             | 1 hour.             |
| For peas (young), squash (spring) . . . . .                  | $\frac{1}{2}$ hour. |
| For dried peas . . . . .                                     | 2 hours.            |
| For winter squash (steam) . . . . .                          | 2 hours.            |
| For oyster-plant . . . . .                                   | 1 hour.             |
| For beets (young) . . . . .                                  | 1 to 2 hours.       |
| For beets (old) . . . . .                                    | 3 to 8 hours.       |
| For asparagus (young) . . . . .                              | $\frac{1}{2}$ hour. |
| For asparagus (old) . . . . .                                | 1 hour.             |
| For artichokes . . . . .                                     | 1 hour.             |
| For winter carrots, parsnips, turnips, and cabbage . . . . . | 2 hours.            |
| For corn . . . . .                                           | 10 to 15 minutes.   |

Roasting.

Roasting is conducted upon the same general principles as boiling. First the sharp heat, and then the pan must be removed to a greater dis-



tance from the fire, to allow a lower heat gradually to penetrate the centre. Roasted meat is more savory than boiled. If properly roasted the meat should be juicy enough to show a quantity of red gravy with the first cut. Before serving the meat it should be ascertained whether it is done or not, and this can be done by drawing it back from the fire and pressing the fleshiest part with the finger. If the cooking be perfect, the flesh will yield to the finger; if not, there will be a little resistance. For fowls and game examine the leg; if the flesh yield and is ready to come away from the bone, the cooking is sufficient. When meat is nearly done there are small jets of steam to be seen coming from the meat at the side next the fire.

#### Time Required for Roasting.

|                                               |                       |
|-----------------------------------------------|-----------------------|
| For beef (rare) to each pound . . . . .       | 10 minutes.           |
| For beef (well-done), to each pound . . . . . | 15 to 20 minutes.     |
| For mutton, to each pound . . . . .           | 15 minutes.           |
| For veal, to each pound . . . . .             | 20 minutes.           |
| For turkey, to each pound . . . . .           | 10 to 12 minutes.     |
| For duck (game) . . . . .                     | $\frac{1}{2}$ hour.   |
| For duck (tame) . . . . .                     | 1 hour.               |
| For capon . . . . .                           | 50 to 60 minutes.     |
| For fowl . . . . .                            | 60 minutes.           |
| For pigeon . . . . .                          | 15 to 30 minutes.     |
| For pheasant . . . . .                        | 35 minutes.           |
| For partridge, woodcock or plovers . . . . .  | 15 minutes.           |
| For grouse, snipe, small birds . . . . .      | 20 minutes.           |
| For larks . . . . .                           | 6 minutes.            |
| For hare . . . . .                            | $1\frac{1}{2}$ hours. |
| For rabbits . . . . .                         | 20 to 60 minutes.     |
| For goose . . . . .                           | 2 hours.              |

#### Broiling.

Some one has said "the gridiron is the thermometer of civilization."

Broiling produces the same effect as roasting, but the proportion of scorched material is greater, on account of the relatively larger amount of surface exposed. The principle of cooking should be the same to retain the central portion juicy. If a cook cannot manage to broil meat well, if her broiling make a greasy, yet burned morsel, she had better fry, for this process is less likely to be a failure; but broiling is better for weak digestions. For good broiling the fire should be prepared at least a quarter of an hour before it is required; a layer of cinders, an inch and a half thick, spread over the hot coals and left to burn clear. If not perfectly clear at the last moment, a little salt thrown on the fire makes it burn more clearly, and frees it from smoke. The gridiron should be clean, and its upper surface well greased, to prevent the meat from sticking. An improved kind of gridiron has its upper surface grooved, and all terminating in a hollow in the handle, so as to save a little of that rich gravy, which would otherwise fall into the fire.

**Time Required for Broiling.**

|                                           |                   |
|-------------------------------------------|-------------------|
| For rump steak, about 1½ pounds . . . . . | 10 to 15 minutes. |
| For fillet steak, 1½ pounds . . . . .     | 7 minutes.        |
| For mutton chop, 5 ounces . . . . .       | 6 minutes.        |
| For sheep's kidney (brisk fire) . . . . . | 4 minutes.        |
| For veal chop, 7 ounces . . . . .         | 9 minutes.        |
| For pork chop, 7 ounces . . . . .         | 9 minutes.        |
| For mackerel . . . . .                    | 10 to 15 minutes. |

**Baking.**

Baking renders meat more impregnated with empyreumatic products, and therefore richer and stronger for the stomach than any other process of cooking.

**Time Required for Baking.**

|                                                      |                   |
|------------------------------------------------------|-------------------|
| For potatoes (with or without skins) . . . . .       | 1 hour.           |
| For egg-plant and tomatoes . . . . .                 | 1 hour.           |
| For omelet . . . . .                                 | 15 to 20 minutes. |
| For eggs (until they set) . . . . .                  | 15 to 20 minutes. |
| For shad . . . . .                                   | 1 hour.           |
| For cod, black fish, and haddock, 4 pounds . . . . . | 1 hour.           |
| For fish generally, 4 to 6 pounds . . . . .          | 1 hour.           |
| For clams . . . . .                                  | 20 minutes.       |

**Frying.**

Frying is also an objectionable process of cooking for persons of weak digestive powers. The article of food becomes more or less penetrated with fatty matter, making it more resistant to the digestive fluids. It is also likely to contain fatty-acid products, arising from the decomposition of the fat used in frying; these are not well borne by the stomach, causing general dyspeptic symptoms, but particularly heart-burn. Frying is less objectionable if the meat or fish is rolled in cracker-dust and egg, and then dropped into hot lard. The egg hardens instantly, and no fat penetrates the inside.

**Stewing.**

Stewing places food in a highly favorable state for digestion. The articles to be cooked are just covered with water, and should be exposed to a heat sufficient only to allow of gentle simmering; much of the nutritive matter passes into the surrounding liquids; this is eaten as well as the solid material.

If properly cooked, the meat should be rendered sufficiently tender to break down under moderate pressure. If boiling is permitted the meat becomes tough.

**Cooking for the Sick.**

As a rule, a woman is the wife, mother, nurse, and cook, all at one and the same time. She cannot cook as nice, dainty dishes as one who has

nothing else to think of but roasting, stewing, and boiling. The busy housewife has found, it is hoped, in the pages of this work, such advice and direction as may make her better able to carry out satisfactorily her arduous tasks, and especially may fit her for that trying and difficult duty—cooking for the sick. For this work she will find the following hints valuable.

Whenever possible, the cooking should not be done in the same room with the patient, for the fuss and smell may destroy what little appetite he has.

Cleanliness is of the utmost importance and should be carried into every detail. No food will be palatable which is not made in clean vessels, nor will an invalid like the appearance of anything which seems not quite free from dust or grease, or other impurities. The napkin spread over the waiter, and the one for the patient's use, should be of the whitest. Cover the table the waiter is to rest on with a towel or mat. Do not serve too much food at a time, and with the tray do not forget flowers and mementos from friends. In fact, all the patient's surroundings should be such as to suggest health, and all that suggests sickness, as medicine, dirty spoons, and glasses, etc., should be removed or kept out of sight. For the same reason it is well never to pour out the medicine before the patient.

There are four causes of starvation among the sick: 1. Defective cooking. 2. Defect in choice of diet. 3. A want of judgment as to hours of taking nourishment. 4. A want of appetite on the part of the patient.

The Bellevue "Manual of Nursing" says upon this subject: "The object of cooking is to make the food digestible and palatable. In the case of the sick, this object must never be forgotten, for with them the food is to be made ready, not for a healthy person, whose digestion can ignore some failings on the part of the cook, but for one whose powers are enfeebled by disease, and for whom the cooking must do a good part of the work of digestion.

"In the first place the food should never be of uncertain quality. If the milk is in that state that suggests sourness, let the patient have some other food, the quality of which is beyond suspicion. So also, if the meat, beef tea, or eggs, are not perfectly fresh, keep them out of the sick-room. The nurse cannot be too careful about these matters, if she does not wish to so offend the stomach of her patient that it will refuse all food. It is important that the nurse should know when the food is well prepared and when it is not.

"In many cases the food is prescribed by the medical attendant, and in hospitals especially the nurse may not have much to do with the choice of food, but in any case an observant nurse can easily find out what kind of food the patient takes with the best relish, and so report to the physician. The fact, however, that the patient likes a certain kind of



food, should not lead the nurse to persist in bringing him this and nothing else, till the relish for this is changed into disgust at the sight of it.

"She should always bear in mind that the appetite of the sick is capricious, and that variety in food cannot be dispensed with. The patient should never be worried with questions as to what he would like to eat, but any choice expressed, should be gratified, if possible.

"If the nurse takes away the food of the patient untouched, or but just tasted of, she must not leave him without food until the time for another meal, or the same thing will be likely to occur again. Let her, instead, bring to him, at an unexpected time, nourishment of some kind, well prepared, or some little delicacy, and thus spare him the weariness and exhaustion which would have been the result of going without food. In no case should the food be left by the bedside of the patient to await the return of appetite. There is no surer means than this of banishing all appetite. Let the nurse ascertain from the medical attendant what quantity of milk, beef-tea, or other food he would wish the patient to take in twenty-four hours, also the quantity of stimulant, if any is being taken, then let her make a little scale of quantities and intervals, arranging also for medicines. Food for the night must not be forgotten, or the patient will be too weak to take anything in the morning. The amount taken at a time will vary with the individual, and in the same case must often be altered to suit the caprice or necessity of the patient. Sometimes two or three teaspoonfuls every hour is better than a larger quantity at a longer interval. Some require food the moment they wake; others cannot take it till later. Practical experience and good sense will do much to teach a nurse what to do in these various cases."

"Again, there is the consideration of want of appetite in the patient. If possible, he should not see, smell, or hear about food before it is brought to him. The nurse should see that things that are intended to be hot, are hot, and not lukewarm. Do not bring a patient warm tea nor coffee a warm mutton chop, nor warm toast. For anything of this kind, previously scald the plates and cups in which it is to be served. Do not let the cups be so full that a part of the contents will be spilled over into the saucer. Bring everything necessary, at once, and not let the patient wait for you to go for salt, spoon, or fork. Do not think it will help the appetite of your patient for him to see you taste of his tea or broth, to assure yourself that it is rightly prepared. Bring only a small quantity of food at once, and let this be made to look as attractive as possible."

# RECIPES FOR HYGIENIC COOKING.

## VARIOUS DIET DRINKS.

### Toast Water.

Toast water, the simplest of all drinks, is also one of the most grateful. It is made by toasting thoroughly on both sides a half slice of bread, a day or two old, and pouring over it

a quart of cold water, then putting it into a hot place and letting it steep for half an hour or so. A small piece of lemon peel may be added, which will improve its flavor.

### Apple Water.

Take two apples, peel them; take out the core, and slice up thinly. Take a small piece of the yellow rind of lemon, enough to give a flavor, and put this with the sliced apples and a little sugar into a jug; pour a pint of boiling

water over them, and when cold, strain ready for use; roasted tart apples may be used in place of fresh ones.

The commencement of the apple season is the best time for making good apple water.

### Wine Whey.

Boil half a pint of milk, and while boiling add a wineglassful of sherry wine. Separate the curd by straining through muslin or a

sieve. Sweeten the whey to taste, and grate upon it a little nutmeg. It will be found very palatable and refreshing.

### Lime Water and Milk.

Take clear lime water and fresh milk, of each a wineglassful; mix. Let a tablespoon-

ful or less be taken at once. This will generally soothe an irritable stomach.

### Lemonade.

To four lemons add a quarter of a pound of loaf sugar and three pints of boiling water; rub some sugar on the rinds of two of the lemons till it is yellow. Strain the juice of

the four lemons (do not use the white pith and seeds), and put the sugar and juice into a jug, and pour the water over it. Cover it till cold. Oranges can be substituted for the lemons.

### Tamarind Water.

Soak tamarinds in cold water an hour; then pour off the water, strain it, and serve. Pru-

nelles and other similar fruits may be served in the same way.

### Milk and Seltzer Water.

Pour together equal quantities of milk and seltzer water. Drink the mixture while it is

fresh. It may also be iced if preferred. This is a refreshing drink.

### Barley Water.

Wash two ounces of pearl barley several times in cold water, which must be thrown away. Then pour on two quarts of boiling water, and boil down to a quart. Flavor with

thinly-cut lemon rind and sugar to taste, but do not strain unless at the patient's request; add the juice of a lemon or of a tart orange if the patient can take acids.

### Flaxseed Tea.

Wash two ounces of flaxseed by putting them in a small strainer and pouring cold water through it; take the yellow rind of half a lemon, as thin as possible; to the flaxseed

and rind add one quart of water; let it simmer for an hour and a half. Strain away the seeds, and to each half pint of tea add a teaspoonful of sugar.

**Rhubarb Water for Spring Drink.**

Take eight ounces of rhubarb, wipe clean with a cloth; cut up into as thin slices as possible; put into a jug; add three ounces of sugar, the yellow rind of half a lemon, the juice of one lemon, and a quart of boiling water. When cold strain for use.

**Hop Tea.**

Pour a quart of boiling water upon half an ounce of hops, cover this over and allow the infusion to stand for fifteen minutes; the tea must then be strained off into another jug. A small teacupful may be drunk in the morning, which will create an appetite and also strengthen the digestive powers. It is an excellent medicinal drink.

**Oat Water.**

Into two quarts of cold water stir a single handful of fresh oats; let it stand fifteen to twenty minutes, or longer. Pour off the water as it is wanted and serve.

**Bread and Butter Broth.**

Spread a slice of well-baked bread with good fresh butter; sprinkle it moderately with salt and black pepper. Pour a pint of boiling water over it, cover and let it stand to cool.

**Sherbet.**

Take powdered white sugar, one pound; carbonate of soda, two ounces; tartaric acid, three ounces. Mix well together and keep in a bottle; when required, mix well a teaspoonful of the mixture in a tumbler of cold water, adding a drop of the essence of lemon.

**Effervescent Draught.**

Squeeze the juice from a lemon, strain, and add to a tumbler of cold water with a little powdered sugar; put in half a teaspoonful of bi-carbonate of soda; drink while effervescing.

**An American Drink.**

Pour the juice of a lemon into a pint of water, in which an ounce of sugar has been dissolved; then add the white of an egg and beat to a froth. It may be iced.

**Milk Lemonade.**

Dissolve six ounces of loaf sugar in a pint of boiling water, and mix with them a quarter of a pint of lemon-juice and the same quantity of sherry, then add three-quarters of a pint of cold milk. Stir the whole well together, and pass it through a strainer until clear.

**Camomile Tea.**

Put about half an ounce of camomile flowers into a jug, pour a pint of boiling water upon them, cover up the tea, and when it has stood about ten minutes pour it off from the flowers into another jug; sweeten with sugar or honey. A cupful of it in the morning will strengthen the digestive organs. A teacupful in which is stirred a large dessert-spoonful of moist sugar and a little grated ginger, is an excellent thing to administer to aged persons a couple of hours before dinner.

**Arrowroot and Black-Currant Drink.**

Take two large spoonfuls of black-currant preserve, boil it in a quart of water, cover it, and stew gently for half an hour; then strain it, and set the liquor again on the fire; then mix a teaspoonful of arrowroot in cold water, and pour the boiling liquor upon it, stirring meanwhile. Let it get quite cold before using. It will be found palatable and refreshing.

**Iceland-Moss Tea.**

Wash one ounce of Iceland moss in cold water to remove impurities. Then heat with water up to nearly the boiling point, and reject the liquid, which has extracted much of the bitter principle. Next boil with a pint of water for ten minutes in a covered vessel, and strain with gentle pressure while hot. The result is a mucilaginous demulcent liquid, with mildly-bitter tonic properties. It may be flavored with sugar, lemon peel, or aromatics; or milk may be used instead of the water, by which a nourishing liquid is obtained.



**Irish-Moss Tea.**

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| <p>Macerate half an ounce of moss in cold water for ten minutes. Remove and boil in three pints of water for a quarter of an hour, and then strain. The tea thus made possesses mucilaginous properties, and may be flavored</p> | <p>with orange or lemon juices and peel, and also with wine. By doubling the quantity of the moss a mucilage is obtained, and when in a highly concentrated state the product solidifies into a jelly on cooling.</p> |
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**Treacle Whey or Posset.**

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| <p>Pour two to three tablespoonfuls of treacle into a pint of boiling milk, and afterwards let</p> | <p>it boil up well and strain. It is frequently used hot as a diaphoretic for a common cold.</p> |
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**Orgeat.**

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| <p>Blanch two ounces of sweet almonds and four bitter almond seeds. Pound with a little orange-flower water into a paste and rub this</p> | <p>with a pint of milk, diluted with a pint of water, until it forms an emulsion. Strain and sweeten with sugar.</p> |
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**Rice Water, or Mucilage of Rice.**

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| <p>Thoroughly wash one ounce of Carolina rice with cold water. Then macerate for three hours in a quart of water kept at a tepid heat, and afterwards boil slowly for an hour, and</p> | <p>strain. This is a useful drink in cases of dysentery, diarrhoea, and irritable states of the alimentary canal. It may be sweetened and flavored like barley water.</p> |
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**Cranberry Tea.**

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| <p>Mash ripe cranberries thoroughly, and pour boiling water over them; let the mixture stand</p> | <p>a few minutes, or till cold; then strain off the water and sweeten to taste.</p> |
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**Antispasmodic Tea.**

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| <p>Infuse two pennyworth of hay saffron in a gill of boiling water in a teacup for ten minutes; add a dessert-spoonful of brandy,</p> | <p>and sugar to sweeten. Drink the tea hot. This harmless remedy will quickly relieve spasmodic pains occasioned by indigestion.</p> |
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**Bran Tea.**

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| <p>Boil a large handful of bran in a quart of water for ten minutes, then strain off the water into a jug, sweeten it with one ounce of gum arabic and a good spoonful of honey.</p> | <p>Stir all well together. This drink may be used in all cases of affections of the chest, such as colds, catarrhs, consumption, and also in cases of measles.</p> |
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**Tamarind Whey.**

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| <p>Stir two tablespoonfuls of tamarinds into a pint of boiling milk, and strain. A quarter</p> | <p>of an ounce of cream of tartar may be similarly treated, and a little sugar added.</p> |
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**Rose Tea.**

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| <p>Take half an ounce of red rosebuds (the white heels being removed), three tablespoonfuls of white-wine vinegar, and one ounce of</p> | <p>sugar or sugar candy. Put them into one quart of boiling water, and let the mixture stand near a fire for two hours; then strain it.</p> |
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**Jelly Water.**

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| <p>Put a dessert-spoonful of wild cherry or blackberry jelly into a goblet of ice water.</p> | <p>Beat up well. This is an excellent drink in cases of fever.</p> |
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**Decoction of Marsh-Mallow.**

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| <p>Add five pints of boiling water to a quarter of a pound of dried marsh-mallow root. Boil</p> | <p>the mixture down to three pints, and strain through a cloth.</p> |
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**Decoction of Camomile.**

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| <p>Take two ounces of camomile flowers and one ounce of fennel seeds; pour over them</p> | <p>four pints of boiling water; let them boil, and strain perfectly clear.</p> |
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**Decoction of Poppy.**

Place a quarter of a pound of white poppy capsules, freed from seeds and bruised, into three pints of boiling water. Boil for ten or fifteen minutes, and then strain.

**Egg Water.**

Blend the whites of two eggs with half a pint of cold water by stirring gently (not beating); add half a teaspoonful of sugar, or half a teaspoonful of salt, to make it palatable. This is highly recommended for children with diarrhœa while teething.

**English Nutritive.**

This is composed of equal parts of soda water and milk. It may be sipped slowly when there is much thirst, but inability to take much liquid.

**Lemon-Peel Water.**

Carefully pare off the rind of one lemon, and placing this in a hot jar, pour upon it one pint of boiling water; cover closely until cool; pour off the fluid, and add a tablespoonful of brandy or two tablespoonfuls of sherry wine. A pleasant summer drink.

**Rennet Whey.**

Take one quart of milk and heat it lukewarm, sweeten and flavor to taste, and then add one dessert-spoonful of liquid rennet. Stand it in a cool place to set, then break up the curd and strain off the whey. It is used in febrile and in inflammatory diseases.

**Milk and Cinnamon Drink.**

Boil in one pint of new milk sufficient cinnamon to flavor it pleasantly, and sweeten it with white sugar. This may be taken cold with a teaspoonful of brandy, and is very good in case of diarrhœa. Children may take it milk-warm without brandy.

**Demulcent Drink.**

Take a pinch of isinglass, and boil it in half a pint of new milk, with half a dozen bruised sweet almonds and three lumps of sugar.

**BROTHS AND GRUELS.****Mutton Broth.**

Put two pounds of scrag of mutton into a saucepan with three pints of water and a little salt. Let it simmer gently two hours; strain it through a sieve; when cold remove every particle of fat. It can be thickened with arrowroot, barley, or ground rice. If the patient can have broth with some of the meat and barley in it, add them; also a little bit of nice brown toast.

**ANOTHER RECIPE.**

Take one pound of meat free from bone, and wash it, put it on the fire with a quart of water; when it boils skim it as clear as pos-

sible by laying a piece of thin blotting-paper on the top, the greasy particles will adhere to the paper, and so free the preparation from them (to an invalid nothing is more disagreeable than broth served with a quantity of fat floating on the top, and to avoid this it is always better to let it get cold, as the fat can then be easily removed). Then add a little more cold water, which will make the scum rise afresh; take it off the stove and season it with parsley root, a small carrot, an onion, and a blade of mace, if the palate of the invalid be strong enough to bear it; boil it an hour and a half at least, till the meat is tender, then strain it.

**Invalid's Broth.**

Cut some chicken, veal, mutton, or beef, up into pieces, and put into a jar with a cover; fill with water, adding a little salt; close down tight, and let it simmer all day on the stove

or range; strain and season to taste. This method extracts all the juice and strength of the meat, and is infinitely better than the customary method of boiling.

**Chicken Broth.**

Remove from a chicken the skin, lungs, liver, etc.; cut the meat from it lengthwise in large strips, then take a sharp knife and cut these strips across the fibres of the meat into thin shavings, removing as much of the fat as possible; put the shavings into a jar; add one salt-spoonful of salt and pour over these as much cold water as will just cover them. Mix up the slices of chicken with the water, so as to prevent the meat from forming a solid mass in the jar; cover the jar with paper; have in readiness a saucepan containing as much cold water as will reach to one inch from the top of the jar; when the jar is placed in it, let it simmer gently over a slow fire for an hour and a quarter, the saucepan being lightly covered. The bones of the chicken are meanwhile to be broken up and placed by themselves in a pint of water, to which has been added a pinch of salt, and allowed to simmer gently until the above is ready. Take all the meat of the chicken out of the jar and pound it thoroughly,

adding by degrees a little of the liquor from the bones and a little water. Press the meat through the back of a hair sieve into a bowl, crushing it through with the back of a wooden spoon. Take a teacupful of the broth made from the bones, and, having first removed by means of a piece of paper any grease there may be on the surface, pour this with the thick meat broth into a saucepan; add four table-spoonfuls of cream, or of milk, if cream be unobtainable or forbidden, and a little salt and pepper; set the saucepan on the fire and boil up. (*Cullingsworth.*)

**ANOTHER RECIPE.**

Skim and chop up small a small chicken, or half a large fowl, and boil it, bones and all, with a blade of mace, a sprig of parsley, and a crust of bread, in a quart of water for an hour, skimming it from time to time. Strain it through a coarse colander. (*Bartholow.*)

**Veal Broth.**

The fleshy part of the knuckle of veal is best. Boil it in a saucepan for two hours and

strain. Pearl barley, rice, vermicelli, or semolino may sometimes be advantageously added.

**Calf's Foot Broth.**

Take two calf's feet; break them up; put them into a pot with two quarts of water, one carrot, a little mace, and salt. Boil two or three hours until only one quart of fluid is left. When done, strain and add a cup of good wine and one teaspoonful of Indian or oat meal.

**ANOTHER RECIPE.**

Place two calf's feet in three pints of water, or in two pints of water and one of new milk flavored with a small bit of lemon peel, and stew them very gently, until the liquid is boiled

down to a pint and a half. Very carefully remove any scum which rises to the surface. Set it by in a basin until quite cold; then take off every particle of fat. Warm up for the patient about half a pint of the broth, adding a little bit of butter, about as large as a nut, a small lump of sugar, and a very small quantity of grated nutmeg. Take it off the fire, add the yolk of an egg, which has previously been well beaten, stir the mixture over the fire until it thickens, but do not allow it to boil again after the egg is added, or it will curdle and the broth will be spoiled.

**Barley Broth.**

Take two pounds of lean mutton, preferably the neck, and boil it in four quarts of water. It should be put into cold water and heated slowly and skimmed well; then add barley and cook two hours and a half; then add the turnip and parsley and cook an hour

longer. Do not cook fast at any time, and stir if there is danger of scorching. Strain and remove all grease. If the patient does not like herbs omit them, also the turnip, and use only the barley and meat. Serve with dry toast or plain corn bread baked with a crust.

**Beef Tea.**

Take one pound of lean beef. With a sharp knife scrape it into fibres; put the scraped meat into a delicately clean saucepan, and pour half a pint of boiling water on it; cover it closely and set it by the fire for ten minutes, and then, having strained into a tea-

cup, place it in a basin of ice-cold water and remove all fat from the surface. Serve in a warm cup. When greater strength is required use half the above quantity of water, or even less if the patient is able to take a spoonful only at a time.

**Jennie June's Beef Tea.**

Cut up half a pound of rump steak into small pieces and put it into a bowl of lukewarm water; cover it and set it where it will gradually heat. In about half an hour turn it into a lined saucepan, cover close, and set it on the range to boil; skim it well as it reaches

the boiling point, and after it has boiled up once or twice, withdraw it from the fire and let it simmer gently in a cooler place for an hour. Strain, and season as preferred. In summer this must be made fresh every day, even if kept in a refrigerator.



**Beef Juice.**

Broil quickly some pieces of round or sirloin steak, of a size to fit in the cavity of a lemon squeezer. Both sides of the beef should be quickly scorched to prevent the escape of the juice, but the interior should not be fully cooked. As soon as ready, the pieces should

be pressed in the lemon-squeezer, previously heated by being dipped in hot water. The juice, as it flows away, should be received into a hot wineglass, and, after being seasoned to the taste with a little salt and a little Cayenne pepper, should be eaten while hot.

**Oatmeal Gruel.**

Pour a pint of boiling water into a saucepan; into this stir a couple of tablespoonfuls of oatmeal until quite smooth; let this boil well for ten or fifteen minutes, season with salt, then strain through a strainer, and add sugar,

This is a soothing and nutritive food, holding a totally different position, on account of the nitrogenous matter present, from the farinaceous preparations. Milk may be used instead of water, or a little brandy added.

**Arrowroot.**

Mix thoroughly two teaspoonfuls of arrowroot with three tablespoonfuls of cold water, and pour on them half a pint of boiling water, stirring well during the time; the arrowroot thickens as it is poured on, and nothing more is necessary. Genuine arrowroot requires no boiling and, if good, it will be quite clear, as clear as good starch; but if muddy or warm water is used it must be put into a saucepan

and boiled until it thickens, carefully stirring all the time, before it can be given to an invalid. Sweeten with loaf sugar, and flavor with lemon peel or nutmeg, or add sherry or brandy if required or ordered by the physician. Milk may be employed instead of water, but when this is done *no wine* must be added, as it would be otherwise curdled. It is not wholesome if insufficiently cooked.

**Corn-Flour Gruel.**

A good gruel can be made by mixing a dessert-spoonful of corn flour, which has first been blended with cold water, into half a pint

of hot water; stir on the fire for ten minutes, sweetening with moist sugar; flavor with nutmeg or a tablespoonful of wine.

**Egg Gruel.**

Beat up an egg to a froth, add a wineglass of sherry, flavor with a lump of sugar, a strip of lemon peel, and a little grated nutmeg.

Have ready some gruel, very smooth and hot, stir in the wine and egg, and serve with sippets toast. Arrowroot may be made the same way.

**Farina Gruel.**

Stir two tablespoonfuls of farina into a quart of water in a milk saucepan; let this boil until it has grown quite thick; add a pint of

milk, a little salt, and let the whole boil fifteen minutes longer; turn out into a bowl, and sweeten to taste.

**Cornmeal Milk Gruel.**

Sweeten a quart of milk, and stir in two tablespoonfuls of cornmeal. This must be cooked with a great deal of care, as the meal is

apt to scorch, and must be stirred constantly while cooking. Use more meal if desired, and flavor with nutmeg.

**Restorative Gruel.**

Take an ounce each of rice, barley, and sago; wash each in cold water; put them into a saucepan, and add a quart of cold water; let it simmer slowly for an hour and a half. Placing a hair sieve over a bowl, press the thick part through,

adding a little of the liquid occasionally; boil in a saucepan, adding a tablespoonful of sugar for each pint of gruel; pour into a basin with four tablespoonful of cream, or, if ordered, two tablespoonfuls of port wine.

**Rice Gruel (for Diarrhœa.)**

Take two ounces of ground rice, a quarter of an ounce of cinnamon, and four pints of

water; boil for forty minutes, and add a tablespoonful of orange marmalade.

**Onion Gruel.**

Slice an onion, and boil it in the quantity of water required for the gruel till quite tender; then add oatmeal, mixed smooth in

cold water, a little fresh butter, a peppercorn or two, etc.; let it boil a few minutes; then strain it.

**Egyptian Porridge.**

Take three tablespoonfuls of lentil flour, a saltspoonful of salt, and one pint of water; mix this into a paste, and boil the mixture ten minutes, stirring all the time.

**Eel Broth.**

Clean half a pound of small eels, and set them on with three pints of water, some parsley, one slice of onion, a few peppercorns; let them simmer till the eels are broken and the broth good; add salt, and strain it off. It will make three half pints of broth.

**SOUPS.****Vegetable Soup.**

Select a nice fresh soup bone, have it partly cracked or broken, but not crushed; put the meat into cold water about four hours before dinner and heat slowly; skin as soon as ready; add barley, keep the pot closely covered, and stew slowly for an hour. Prepare the vegetables, which will be four white potatoes sliced, a little cabbage, one carrot sliced fine, two turnips, one leek, and one stalk of celery cut fine; add barley, or, instead, rice, noodles, vermicelli, or rivels. The potatoes and all but rice and barley should be added last when used. Corn cut from the ear and green peas can be used to suit the taste.

**Milk Soup with Vermicelli.**

Take one quart of boiling milk and salt it to the taste; then drop lightly into it two ounces of vermicelli; keep stirring the milk as this is added, to prevent its gathering into lumps; stir frequently from fifteen to twenty minutes. Add any flavoring that may be desired.

**Lentil Soup.**

Take half a pound of uncrushed lentils, one carrot chopped fine, three onions, one leek, two pounds of parsnips, an ounce of chopped parsley, pepper, salt, a dessert-spoonful of brown sugar, and three large crusts of bread. Soak all night; boil with some soda in a large saucepan for three hours; press them through a colander; heat all again, and serve.

**Curry Soup.**

Skin and scald two onions, chop them up with one large apple, put them into a stewpan with one ounce of butter or dripping, and brown them; draw the pan to the side of the fire; then place half a teaspoonful of curry powder into three pints of cold water, put it into the pan with half a teaspoonful of sugar, half a teaspoonful of salt, and a quarter of a pound of well-washed rice; boil for three-quarters of an hour, stirring occasionally.

**Barley Soup.**

In four quarts of water put two pounds of pieces of meat, a quarter of a pound of pearl barley, four sliced onions, salt and pepper, with a little parsley; let the whole simmer for three hours or more. This makes a very nutritious soup.

**Eel Soup.**

Take three pounds of small eels; put to them two quarts of water, a crust of bread, three blades of mace, some whole pepper, (an onion if liked), and a bunch of sweet herbs; cover them close, and stew till the fish are quite broken, then strain off. Toast some bread, cut it into small squares, and pour the soup on it boiling. A quarter of a pint of cream, with a teaspoonful of flour rubbed smooth in it, is a great improvement.

**Oyster Soup.**

Drain the liquor from fifty fresh oysters, and heat it slowly in a porcelain kettle; then heat two quarts of milk in a double boiler until it boils; let the liquor of the oysters boil, and put in the oysters as soon as boiled; add the milk at once and remove from the hot fire. The oysters will be cooked sufficiently. Season with six whole peppers, a little salt and butter. If the oysters are salts, care should be taken that the milk does not curdle.

**Soup for Invalids.**

Boil two pounds of lean veal and a quarter of a pound of pearl barley in a quart of water very slowly, until it becomes of the consistency of cream. Pass it through a fine sieve and

salt it to taste. Flavor it with celery seed, if liked, or use fresh celery, if in season, a very small quantity will suffice. Let it simmer very slowly. This soup is very nourishing.

**Rabbit Soup.**

Boil the rabbit, cut the flesh off the bones and mince it, and break the bones up small. Put into a stewpan the liquor in which the rabbit has been boiled, and the meat and broken bones. Let it simmer gently, skimming carefully, for half an hour after it boils. Then add an onion, and some parsley, thyme and marjoram, a stalk of celery, or celery seed tied up in a bit of thin muslin, some whole

white pepper and a little salt. Let it simmer for a quarter of an hour longer, and then strain. Put this stock into a stew pan, and add a teacupful of milk. If neither cream nor new milk can be used, add skim milk, as all the oily properties have been taken away; then boil again, adding thickening ready blended; this may be a teaspoonful of arrowroot, cornmeal, or good flour.

**Lamb's-Shank Soup.**

Free the shanks of the toes by holding them in red-hot cinders, which will cause them to come off; then put the shanks into boiling water and the skin will come off, without the least trouble; break the bone up

into small pieces and proceed as in the rabbit soup. The stock will be found on cooling to be a strong jelly, exceedingly nutritious. A tablespoonful of arrowroot or corn flour will be enough to thicken the quantity used at a time.

**Sago Soup.**

Boil an ounce of sago in a pint of weak beef

tea or broth until it be well dissolved.

**Mutton Soup.**

Select a nice shoulder of mutton; put it on to boil in two quarts of luke-warm water; when the meat is half cooked add the herbs tied up in a coarse cloth; then add one pared turnip and some celery cut into small pieces, one carrot cut fine, one leek. When all is almost done, add two potatoes cut fine, and noodles or rivels, vermicelli or macaroni.

Noodles are made nicely by breaking into a cup of flour salted to taste, one egg, and mixing to a paste that can be rolled out very thin, and then placing before the fire until it is dry enough to cut in long strips. When tomatoes are liked, two raw ones or half a can of canned ones add very much indeed to the flavor and gives it a much richer color.

**Bread Soup.**

Let the stock simmer over the fire three or four hours; place in a bowl bits of bread, no matter how hard and stale; pour over them

enough hot broth to soak them well; mash fine, and put the whole into the stock. Let it continue to simmer a few minutes longer.

**Vermicelli Soup.**

Take a shin of veal and put it in four quarts of water, adding one onion, or leek, two carrots, two turnips (white), and a little salt. Boil this three hours; add two cups of vermi-

celli, and boil it an hour and a half longer. When ready for the table remove the bone. The vegetables also may be taken out and the broth served clear.

**French Soup.**

Put a gallon of water to a sheep's head nicely cleaned; then reduce it to half the quantity, and add a teacupful of pearl barley, half a dozen large onions, a turnip, a carrot, a

bunch of sweet herbs, pepper, salt, cloves, and a little mushroom or walnut catsup; strain all off, cut part of the head in pieces and serve it in the soup, with a little white wine.

**Onion Soup with Milk.**

Slice some onions into a stew pan, with a piece of butter or lard, and a little flour; when brown add a quart of boiling milk, pepper, salt, and any cold cooked vegetables

at hand; boil up once or twice and you have a delicious food, without meat or stock. Water can be used instead of milk, and sift in a little flour or bread crumbs, and brown well.



**German Pancake Soup.**

Make a batter with a pound of flour, a little salt, half a pint of milk; stir well, and add two eggs beaten. It should not be too thick, the consistency of cream is right. Make into pancakes, fried to a very pale yellow. As each one is fried lay it on a board and double over once; cut into strips half an inch wide; put them into a soup tureen and pour good stock, well seasoned and strained, over them. Serve hot, and as soon as possible.

**Green-Pea Soup.**

Take two quarts of shelled peas; boil the pods in two quarts of water until the volume is reduced to one quart. When cool, put in the peas and boil them; when half done add two quarts of new milk, let this boil, being careful it does not scorch, and then serve. Season with butter, pepper and a little salt. This soup is a favorite at fashionable dinners.

**Mock-Turtle Soup.**

Parboil a calf's head, divided, and cut all the meat into small pieces; then break the bones and boil them in some beef broth; fry some shalots in butter, add flour to thicken, and stir them in; skim carefully while boiling; add a pint of white wine; let the whole simmer till the meat is perfectly tender; then put in some chives, parsley, basil, salt, cayenne, soy, and mushroom catsup to your taste, and boil for ten minutes; squeeze a little lemon juice into the tureen and pour the soup on it. Serve with four meat balls.

**Sheep's-Head Soup.**

Cut a sheep's liver and lights into pieces, and stew them in four quarts of water, with some onions, carrots, and turnips, half a pound of pearl barley, pepper, salt, cloves, and a little marjoram, parsley, and thyme. Stew all these until nearly done; then put in the sheep's head and boil until quite tender; then it should be taken out and everything strained from the liquor. Let this stand till cool; take off the fat, and thicken it with butter and flour. A glass of wine may be put into the tureen, if desired, before pouring in the soup.

**Tapioca Soup.**

Put two ounces and a half of tapioca into one quart of cold stock and bring it gradually to the boiling point. Let it simmer gently till tender, and serve.

**Macaroni Soup.**

Take one ounce and a half of macaroni, a small piece of butter, and a pinch of salt. Put them into boiling water and let them simmer half an hour. When tender drain and cut into thin rings or lengths, and drop into the boiling soup stock. Stew gently fifteen minutes.

**Split-Pea Soup.**

Boil one pint of peas in three quarts of water till they become broken to bits; add any vegetable that is liked one hour before the soup is to be served. The best peas require three and a half hours to cook them. One tablespoonful of olive oil will improve the soup.

**Semolina Soup.**

Drop an ounce of semolina into one pint of boiling stock and stir constantly to prevent burning. Let it simmer gently for half an hour. Season with a little salt.

**Oyster Crab Soup.**

Take one quart of rich milk and one pint of oyster crabs; wash the crabs in cold water and strain the water from them; put the milk into the saucepan and place it on the fire, then throw in the crabs; season with salt, pepper, and a small piece of butter.

**Soup Bouillabaisse.**

Take cod fish, black bass, lobster, shrimp, or any similar fish. Place in a large stewpan three or four onions cut in slices, three or four tablespoonfuls of (Creme de Lucca) olive oil, and fry to a light brown. Cut the fish into pieces of two or three inches square to cover the bottom of a pan; cover them with warm water; add a teaspoonful of salt to each pound of fish, the juice of two lemons, five or six tomatoes, a piece of garlic, a half teaspoonful of cayenne pepper, and three or four glasses of sherry wine. Place the pan on the fire, boil rapidly for fifteen minutes, then add a small portion of saffron and a tablespoonful of chopped parsley, and let the whole boil a minute or two longer, and then set aside on the range. Serve in a tureen lined with thin slices of dry toast, and serve immediately.

**Lorraine Soup.**

Rub to a paste a pound of blanched sweet almonds, moistened with a little water; add to this the white meat of a cold roast fowl and the yolks of four hard-boiled eggs; pound well, seasoning with salt, mace, and nutmeg to

taste; let the mixture be boiled over a slow fire in three quarts of strong veal broth, perfectly free from fat. This soup is ready to serve when it has become of the consistency of cream.

**Snapper Soup.**

Make, according to the quantity of snapper, a good stock from knuckles of veal and shins of beef. Kill and bleed the snappers and remove their entrails. Take out the meat and eggs (if any), break the shells in pieces and put in the stock to boil. Then put in the snapper meat, and, when cooked, take it out, cut it into small pieces and set aside until wanted. Now add to the stock tomatoes,

onions in slices, and all kinds of sweet herbs. Boil well and strain off the stock, thicken with brown flour and season well with salt and pepper. Add the juice of two lemons, and lastly the snapper meat. If there are no eggs in the snapper add chicken eggs, a little flour and milk or water. Boil separately and add them to the soup just before dishing it up. When all is done flavor with brandy or Madeira wine.

**Clam Soup.**

Wash twenty-five good-sized clams thoroughly, and when perfectly clean, boil them in their shells with *very little* water. The water should be boiling when the clams are put in. In a few minutes the clam shells will open and the juice run out. Remove them from the shells and chop them up as *fine* as possible, and press them through a coarse sieve, adding a

finely-chopped onion, some minced celery, and a little mace and pepper. Then strain the liquor in which they were boiled, stir into it all the ingredients, and boil it fifteen minutes, adding a little milk and thickening with flour and butter. Then remove from the fire and stir in the well-beaten yolks of two eggs. Serve the soup in a tureen, lined with toast.

**Chicken Soup.**

Take a chicken weighing about three pounds. Cut it into quarters and place in a porcelain pot. Add two quarts of water and let it boil one hour. Then have a frying pan ready, with a lump of butter, and remove the chicken to it, and have some boiled rice ready, cooked in another saucepan—about one cupful of boiled rice—as boiling the rice with the chicken im-

proves the flavor of the soup. Add about one tablespoonful of chopped parsley, one onion, and a small carrot, in very thin slices; boil the giblets separately, and when the chicken is a rich brown remove it to make a gravy by adding a half cup of water, one tablespoonful of flour, and the giblets chopped fine. Serve the gravy separately.

**Mulligatawny Soup.**

This Indian dish is admired by many. The meat may be either veal, rabbit or fowls. Get a knuckle of veal; have the bones cracked in two or three pieces; put it into a stewpan, cover it with water, and, when it is rather more than half done, cut off as much meat as you wish for the soup, and boil the bones and the remainder of the meat well down to make stock soup; let this stand until cold, and then

remove the fat; cut the meat into small pieces, and fry them in butter, with four onions sliced and floured, two dessert-spoonfuls of curry-powder, a little cayenne pepper and salt; put these into the stewpan; add the stock gravy, with three or four cloves, and a good tablespoonful of lemon juice; let the whole simmer for an hour, and serve up with some plain boiled rice in a separate dish.

**Economical Veal Soup.**

Boil a piece of veal, suitable for a fricassee, pie or hash. When tender, take the meat up and slip out the bones; put these back into the kettle and boil two hours; then strain the liquor and stand away until the next day.

When wanted, take off the fat; put the soup into a clean pot; add pepper, salt, an onion, a half teacupful of rice, a tablespoonful of flour mixed in cold water, and slices of potatoes; boil thirty minutes and serve hot.

**Okra Soup.**

To five quarts of water and a shin of beef add four dozen okras, sliced thin, and a few to-

matoes; boil from six to seven hours, and add salt and red pepper to taste.

**Beef Soup.**

Prepare the extract; add a tumbler of boiled milk, slightly thickened with flour (see

that there are no lumps in it); flavor with extract of celery.

## EGGS AND MILK FOODS.

## Boiled Eggs.

Put the eggs into boiling water, and boil three minutes for soft-boiled ; five minutes for hard-boiling, and fifteen for hard-boiled for an invalid. Eggs boiled fifteen minutes or considerably longer if convenient, are easily digestible by the most delicate stomach. Sometimes physicians direct that the patient have eggs which have been boiled two hours.

As an alternative, the following is subjoined.

## ANOTHER RECIPE.

Cover the eggs with boiling water, and put them in a place on the range where the water will keep boiling hot, but *not boil* ; let them stand seven minutes ; when they will be found deliciously jellied and perfectly digestible.

## Poached Eggs.

Fill a fryingpan half full of boiling water, and add a little salt ; break the eggs separately into a cup, and pour them carefully into the water whilst boiling, watching each so as to shape the whites, or place muffin rings in the

water and pour the eggs into them. Have enough water to cover them. Remove carefully so as not to break them. They can be served on buttered toast or alone. Two and a half minutes is sufficient time to cook them.

## Egg Nogg.

Beat the yolk of one egg, sweetened with one tablespoonful of sugar to a cream ; add half a cup of milk and a tablespoonful of

whiskey ; beat the white to a stiff froth, and stir it into the other very lightly. Omit the milk when more nourishment is desired.

## Egg and Sherry.

Beat up an egg till it froths ; add a lump of sugar and two tablespoonfuls of water ;

mix well, pour into it a wine-glassful of sherry, and serve before it gets flat.

## Milk, Egg, and Brandy.

Scald some new milk, *but do not let it boil* ; when this is cold, beat to a froth an egg sweetened with a lump of sugar ; add a dessert-

spoonful of brandy, and fill up the glass with the milk. This food is given in any weakening disease to sustain the strength.

## Mulled Egg.

Toast a piece of bread nice and brown ; beat up an egg very light in a bowl, then boil one and a half cups of milk, sweeten, and

while hot pour on the egg, and add the toast cut into small pieces. This is a delightful food for an invalid.

## Sherry, or Brandy and Milk.

To one tablespoonful of brandy, or one wine-glassful of sherry, in a bowl, add sugar and a very little nutmeg for flavor ; warm a

cupful of new milk, and pour it into a spouted jug ; pour the contents from a height over the wine, sugar, etc. *The milk must not boil.*

## Mulled Wine.

Boil some spices, cloves, nutmeg, cinnamon, or mace, in a little water ; then add a wine-glass of sherry, or any kind of wine, and some

sugar ; bring it to the boiling point, and serve with toast. If claret is used, it will require a good deal of sugar.

## Milk, Whisky, and Isinglass.

Dissolve a teaspoonful of isinglass in a little hot water over the fire ; let it cool, and mix a dessert-spoonful of whisky with it in a tumbler

and fill up the glass with new milk. The liquor can be omitted ; if so, boil the milk, and sweeten if preferred.

## Egg and Brandy.

Beat up three eggs to a froth, add four ounces of water, two or three lumps of sugar,

and pour in four ounces of brandy, stirring all the time.

## Milk Blanc-Mange.

Take one quart of milk, a teacupful of sugar, and an ounce of isinglass ; put them into a lined saucepan until the isinglass is dissolved ;

keep stirring it over the fire for ten minutes ; strain through a fine sieve ; when nearly cold pour into an oiled mould.



**Milk Toast.**

Toast one or two thin slices of bread. Boil a cup of sweet milk and season with a little salt and butter; lay the toast in a hot, deep plate, and pour the milk over it.

**Cold Milk Toast.**

Toast some bread nicely and then pound it almost to a powder; place it in a bowl and pour over it some cold milk, either salted or sweetened.

**Milk Porridge.**

Stir into one quart of boiling milk two tablespoonfuls of flour mixed with a little cold milk and half a teaspoonful of salt. Boil half an hour; strain before serving. A handful of raisins and a little grated nutmeg may be boiled with it.

**Rice Milk.**

Wash three tablespoonfuls of rice, put it in a saucepan with some milk, and let it simmer gently till the rice is tender, stirring it now and then to prevent its burning. Sweeten a little and serve with a cut lemon, black-currant jam or stewed apples.

**Arrowroot, Lime Water and Milk.**

Take equal parts of milk, arrowroot water and lime water, and sweeten to taste. The most delicate stomach can digest this food, and at the same time is very nourishing.

**Caudle.**

Mix together one pint of cold gruel and a wine-glassful of good cream; add a wine-glassful of sherry and a tablespoonful of noyau, and sweeten with sugar candy.

**Milk Lemonade.**

Dissolve six ounces of loaf sugar in a pint of boiling water, and stir in a quarter of a pint of lemon juice and the same quantity of sherry; then add three-quarters of a pint of cold milk.

**Indian-Meal Milk Gruel.**

Sweeten one quart of milk and stir into it two tablespoonfuls of cornmeal; this must be cooked carefully and stirred whilst cooking, as it may scorch; flavor with nutmeg; more meal must be used if it is not as thick as desired.

**Milk and Suet.**

Boil one ounce of finely-chopped suet in a quarter of a pint of water for ten minutes, and then press it through linen or flannel; add one teaspoonful of cinnamon, one ounce of sugar, and one cup of milk; boil again for ten minutes, and strain; use a wine-glassful of the suet with a quarter of a pint of milk. This is a highly nutritive and fattening article.

**Flour and Milk.**

Tie some flour up tightly in a cloth, boil it slowly in water for ten or twelve hours. The flour becomes agglomerated into a hard mass, and is only wetted on the surface; after drying mix one grated tablespoonful with a pint of milk and boil. This is a nourishing and useful remedy for dysentery and diarrhoea, and one which should be more generally known.

**Arrowroot Blanc-Mange.**

Mix two tablespoonfuls of arrowroot, three-quarters of a pint of milk, and lemon and sugar to suit the taste; omit the lemon if the patient cannot have acids.

**Thickened Milk.**

Mix a tablespoonful of flour smooth with a little milk; pour upon it a quart of boiling milk, and when it is thoroughly amalgamated boil up the whole once, stirring all the time to keep it smooth and free from lumps; serve with dry toast. It becomes specific by scorching the flour first, before you mix it. This is excellent food in cases of diarrhoea.

**Scrambled Eggs.**

Beat up a dozen eggs and turn them into a pan in which a little butter has been allowed to melt, season with a little pepper and salt, and toss about rapidly to prevent sticking.

**Egg Omelet.**

Beat up four eggs till they are light; add them to one pint of milk, with a little pepper and salt, and a teacupful of flour; beat well all the lumps. Have ready a fryingpan with equal parts of lard and melted butter in it; and stir into this the batter with a fork until it thickens; bake to a light brown, and serve while hot.

**Eggs and Cheese.**

Into a pie-dish put half a teacupful of cream or milk; thicken with flour; break into it some six or eight eggs without breaking the yolk; sprinkle over it some grated cheese, and a little pepper; bake in an oven, without allowing the yolks to harden.

**Milk Sherbet.**

Squeeze the juice of six lemons over a half a pound of sugar, take off the skins very thin and put them into a pint of water, and place on the fire; let them simmer a few minutes; pour the liquid upon the sugar; scald two quarts of milk with the corn starch mixed in it, and add the sugar; when cold put it into a freezer; when it begins to stiffen add the syrup of lemon juice and sugar, and then freeze until it becomes an ice.

**Savory Eggs.**

Break five eggs into a dish, add a pinch of salt and some pepper, and a little chopped thyme; beat them well together; rub a small pan twice with an onion, place in it two ounces of fresh butter, and boil the whole; when boiling pour in the eggs; stir quickly until cooked about ten minutes, then turn on to a hot dish, and serve immediately.

**Sweet Eggs.**

Divide the yolks of ten perfectly fresh eggs from the whites; add to the yolks four dessert-spoonfuls of sugar pounded fine, and beat them ten minutes; whip the whites with a wire whisk till in a stiff froth; add five dessert-spoonfuls of pounded sugar and some vanilla essence, and whip until well mixed; put the yolks into an enamelled saucepan, and stir over the fire until as thick as cream; care should be taken to prevent curdling by being overdone. When a little cool pour in a dish, and pour the whip over it.

**Eggs Au Gratin.**

Cut some hard-boiled eggs into slices, lay them on a well-buttered dish; next put a spoonful of white sauce into a stewpan, with two ounces of Parmesan cheese, a small piece of butter, the yolks of three eggs, and a little pepper; stir over the fire till it begins to thicken, pour it over the hard-boiled eggs, sprinkle bread crumbs over all, put the dish in the oven, and serve as soon as the contents begin to brown.

**Baked Milk.**

Put into an earthen pot two quarts of new milk, cover it tightly, and tie a sheet of writing paper over it, place in the oven, and cook *very slowly* for eight or ten hours, until it is like thick cream; sweeten to taste and flavor with any extract that is agreeable.

**Scalloped Eggs.**

Boil five or six eggs hard, chop them up roughly, make a white sauce, and mix all up well together; butter a pan, and put in it a layer of bread crumbs, and then a layer of egg, and so on until full; finish with bread crumbs on top; bake to a light brown.

**FRUITS AND JELLIES.****Roasted Apples.**

Take tart apples; wipe each clean and put in the oven to roast. As soon as they are soft to the core take them out and cool them. Serve with sugar and cream if desired.

**Baked Apples.**

Select smooth, fair apples; remove the blossom end and core; place in an earthen or tin pie plate; if tart, crowd them; if sweet, keep them separate; pour a cupful of cold water into the plate and set the plate, covered, in an oven to bake. Do not let the apples get

dry, as it will burn up the juice; add a little sugar to the juice, or put some sugar into the core holes and cover each with a little slice of lemon, first lightly squeezing the juice over the apples. Sweet apples are preferred for baking. Serve with cream.

**Steamed Apples.**

Prepare as for baking, and steam two or three hours, or until soft. Serve as above.

**Stewed Apples.**

Select apples not too ripe; pare, core, and slice them into thin pieces; wash hastily, or place them in cold water while cutting, so as to remove the rust which a steel knife always imparts; put them into a porcelain kettle and

add cold water to make them moderately juicy; cook till soft; stew *quickly* if tart, *slowly* if sweet, and do not stir, and the pieces will hold together unbroken, swimming in the clear juice. When tart, sweeten while hot and leave to cool.

**Apple Jelly.**

Cut the apples, cores, skins and all, into thin slices, and put them into water enough to cover them; boil until soft; then strain

through a strain-cloth and add three-quarters of a pound of sugar to one pint of juice; boil until it jellies, and then pour into moulds.

**Baked Peaches.**

Take good clingstone peaches, wash them well, and do not pare them; fill a stone jar nearly full; add a pint or more of cold water;

cover, and bake in a very slow oven about two hours. If the peaches are tart less cooking and less water is required. Sweeten to taste.

**Stewed Dried Peaches.**

Pared peaches are best, as the skin is disagreeable to most persons, let them soak in warm

water on the back of the stove until quite tender, then finish over a quick fire; sweeten to taste.

**Grape Jelly.**

Press the juice from the grapes, and to each pound (a pint is a pound) of juice add one pound of sugar. Currants, plums (gages),

quinces, blackberries, strawberries, and all fruits may be used in the same manner. Quinces have to be boiled before being pressed.

**Orange Jelly.**

In one quart of water boil two ounces of isinglass until it becomes a strong jelly; add

the juice of four oranges, and a little sugar. Lemons can be used instead of oranges.

**Cider Jelly.**

Boil new cider to the consistency of syrup, adding one pound of white sugar to a gallon of

cider; skim it and let it cool. It will be a beautiful clear jelly, very nice to make a drink.

**Wine Jelly.**

To one pint of wine add one ounce of isin-

glass, half a pound of sugar, and spices to taste.

**Calf's-Foot Jelly.**

Place four calf's feet into four quarts of boiling water and boil until reduced to one quart; then strain, and when cold, take off the top. In taking out the jelly avoid the settlings. To a quart add six ounces of loaf sugar, the crushed shells and the whites of five eggs very well beaten, half an ounce of clarified isinglass, the juice of two lemons and a glass of sherry wine; after the mixture has stood a few minutes, put the pan over a gentle fire, and stir until the liquid boils and rises in the pan, but

do not stir it after this stage is reached; let it boil twenty minutes, removing the scum carefully as it rises; now remove from the stove to one side and let it settle for twenty minutes; then pour the jelly through a jelly bag made of flannel, first wringing the bag out in hot water. Do not put the jelly into metal moulds to remain for any length of time as the action of the metal will be apt to affect the color. Keep it in a cool place; in summer surround it with ice.



**Jelly from Gelatine.**

Take two ounces of gelatine and soak for an hour or so in cold water until soft; add to this one and a half pounds of sugar, the juice of four lemons, and orange peel (stick-cinnamon or other flavoring) when soaked thor-

oughly, pour on three pints of boiling water and strain immediately through a fine hair sieve; pour into moulds and set aside to cool. When required for an invalid, add one wine-glassful of sherry wine.

**Beef Jelly.**

Take one pound of round steak, free from fat, cut into small pieces and put into a wide-mouthed bottle (or what is better, an earthen jar); barely cover the meat with cold water, set the jar in a kettle of water and let it boil one hour; add to the juice thus obtained two

wine glasses of best sherry wine, the juice of one lemon and a quarter of a box of gelatine or enough to set the jelly; pour into very small cups or moulds and turn out upon a saucer when ready to serve. A very delightful and nutritious jelly.

**Jelly for a Child with Weak Limbs.**

Buy two pounds of shin beef-bone; it is no object to have much meat upon it; chop it up into small pieces, wash and put them into a saucepan, with a quart of water and a good pinch of salt; boil very gently for six or eight hours, the object being to extract the lime from

the bones; then strain through a jelly bag; when cool remove the fat; if no meat was on the bone the jelly will be quite tasteless, but very firm; it may be dissolved in warm milk, or a little sugar may be added to induce the child to take it.

**Rice Jelly.**

Take a quarter of a pound of rice flour, and half a pound of loaf sugar, and boil them in a quart of water; when they become a glutinous

mass, strain off the jelly, add wine or lemon juice and let it stand until it is entirely cold before serving.

**Strawberry Ice.**

Press one pound and a half of strawberries through a hair sieve; they will make a little over a pint of pulp; add one pint of syrup of ordinary consistency; also a gill of red currant

juice or the juice of half a lemon, and a pint of water; mix the ingredients and work the composition in the freezer; use when sufficiently frozen.

**Mutton Jelly.**

Put six mutton shanks, half a pound of lean beef and a little pepper and salt, in three pints of water, and let them simmer gently for five

hours; strain, and when cold take off the fat. Warm up as much as is wanted at a time, and keep the rest in a cool place.

**Chicken Jelly.**

Pound together the bones and meat of half a raw chicken and cover them with cold water; heat slowly in a covered vessel and let it stand until the meat is in white rags, and the liquid

reduced to one-half; strain through a fine sieve, add salt and cook a few minutes longer. Wine or other seasonings may be added, according to special tastes.

**Arrowroot Wine Jelly.**

Take one cupful of boiling water, two teaspoonfuls of white sugar, and one dessert-spoonful of brandy, or three of wine; wet the arrowroot in a little cold water and rub smooth,

then stir into the hot water with the sugar melted in it; boil it, and stir until clear, and add the wine and brandy; pour into moulds. Lemon or orange may be used instead of wine.

**Iceland Moss Jelly.**

Soak one handful of Iceland moss in cold water; then stir in one quart of boiling water, and let it simmer till dissolved; add the juice

of two lemons, one glass of wine, and a little cinnamon; sweeten to taste and strain into moulds. Irish moss can be used the same way.

**Stewed Prunes.**

Wash the fruit and allow half a pound of sugar to each pound of fruit; put on the stove

and cook slowly for two hours. They are very nice for a sick person when a little warm.

**Cranberry Jelly.**

This is made like currant jelly. When the juice is expelled, strain, and to every pint of juice add a pound of sugar; boil until it thickens, and skim it. Serve with roast turkey.

**Farina Jelly.**

Boil three pints of milk, and whilst boiling sprinkle slowly one-quarter of a pound or four tablespoonfuls of farina; continue to boil for about three-quarters of an hour; when done turn into a mould and place on ice. It makes a beautiful ornament for the table.

**Orange Water-Ice.**

Rub the best part of four oranges upon a half dozen lumps of sugar, being careful in this not to rub the under skin; put the flavored lumps into a little warm syrup and let them remain until dissolved; now take a dozen fine Florida oranges and two lemons, and strain the juice, adding a pint of water and one quart of clarified sugar to the flavored syrup; mix and freeze. Pineapples, cherries, lemons, or any other fruit may be used in the same way. In using lemons always add oranges. Coffee-ice is made by dissolving a pound of sugar in one quart of water, and adding half a pint of strong coffee and the white of one egg.

**Apple Butter.**

Boil ten gallons of sweet cider in a brass kettle until reduced to five gallons; take a bushel of apples, wash, drain and put them into the boiled cider, and when soft stir constantly until finished with a wooden spoon; two hours will be required to cook slowly, if for winter use. Before taking it from the fire add cinnamon and clove to taste; remove from fire, and while hot pour the butter into a well glazed crock or stone jar, and set away to cool.

**Peach Butter.**

Pare and slice fine the peaches and proceed as in apple butter, only adding water instead of cider; quince and other fruits may be substituted. Marmalade can be made by adding three-quarters of a pound of sugar to each pound of pulp.

**Port Wine Jelly.**

Take one pint of port wine, one ounce of isinglass, and one ounce of sugar; put the isinglass in water to dissolve; add the wine, strain, and set to jelly.

**MEATS AND GAME.****Roast Beef.**

The sirloin and rib pieces are the best for roasting; have the butcher bone and roll the meat, basting it together with the skewers, but avoid many skewers, as they allow the gravy to escape. Place the meat in a dripping-pan with a little water and put into a hot oven for ten or fifteen minutes until a crust is formed to imprison its juices; then lower the temperature, and keep at a steady, moderate heat; season with salt and pepper on both sides; cook until done as desired. For gravy, pour off the fat from the drippings into a little water and thicken with flour browned, or let the gravy cook a few minutes. Do not baste roast beef.

**Roast Mutton.**

A nice shoulder or chime is generally used for roasting. It is best to wash mutton in cold or lukewarm water and dry it with a clean cloth. Place it in a dripping-pan in a hot oven with a little water; after searing the surface, top and bottom, cook moderately in a steady heat; it requires a little basting; roast fifteen minutes for each pound of the meat. A shoulder is nice boned and filled with bread filling seasoned with thyme, salt, and pepper. This gives a delicious flavor to the meat. If gravy is needed make it in the same way as beef gravy.

**Roast Lamb.**

The fore and hind quarters are used for roasting; proceed as in roasting mutton.

**Roast Veal.**

Take out the bone of a fillet of veal, and prepare a filling of bread, thyme, pepper and salt, and fill with it the cavity (onion can be used also in the dressing); then roast the meat in a moderately hot oven, as veal takes long and slow cooking; when cooked to a nice light

brown, remove. It should be basted while cooking. If gravy is desired make it in the same way as beef gravy. Veal is so very dry that a moist dressing is almost essential. The shoulder, loin, knuckle, and breast may be roasted the same way.

**Roast Pork.**

Bone a leg as in mutton, filled if preferred, only substituting sage or sweet marjoram for the thyme; onion may also be used if the flavor is liked. Make gravy as for beef. The

spare-ribs, leg, and loin are all delicious when roasted and cut cold. A young pig three or four weeks old can be roasted whole. It should be roasted slowly, and requires long cooking.

**Pork Cutlets.**

Cut the meat half an inch thick. In broiling sprinkle a little pepper on them, and when almost done add a little salt. When frying,

flour them well and season with salt, pepper, and sage; fry over a slow fire, and let it cook until brown.

**Ham Croquettes.**

Chop the ham very fine, and season with pepper and mustard; with a little flour in the hands make up into small balls, dip them first

into well-beaten egg and afterward into cracker dust or bread crumbs; fry to a light brown. and serve while fresh.

**Ham Omelet.**

Beat up four eggs very light; add enough fine-chopped ham to flavor it; fry in hot butter

till brown on the lower side; sprinkle salt and pepper over it, and fold over one half.

**Boiled Ham.**

Put the ham into warm water, and boil it for five or six hours; if very salt the water may be changed once, but the temperature of the fresh water should be the same as of that already used; when done take off the skin.

Before serving stick cloves at intervals with a ring of black pepper, and garnish with parsley. Boiled ham is best eaten cold. It can be made delicious by sprinkling sugar over it and baking an hour.

**Potted Ham.**

Cut the remains of cold boiled ham in small pieces, and pound it little by little in a mortar, softening it during the process with melted butter; add cayenne pepper to taste;

put it in a jar, pressing it down very smooth; cover it with a little melted butter, and close up tight and set away. It will keep well and as long as desired.

**Veal Cutlets.**

Take the cutlets—those from the leg are best—and cut them into pieces as nearly of a size as possible; dip them into well-beaten egg, and

then into cracker dust, and fry slowly to a golden brown. If the veal is tough parboil it for ten or fifteen minutes; dry before frying.

**Veal Omelet.**

Chop up very fine three pounds of veal, and with it mix six powdered crackers, a tablespoonful of salt, one of thyme, one of sage, half

a tablespoonful of pepper, and half a teacupful of milk; mix and form a loaf; baste with milk and butter while baking, and bake two hours.

**Scalloped Veal.**

Cut up fine some cold roast veal, and put a layer of it in the bottom of a buttered dish, and season it with salt and pepper; then add a layer of cracker dust and a few pieces of butter and some milk, and season again; proceed in this way until the dish is full; well with diluted gravy; spread over the top a

thick layer of paste made of cracker dust, a little milk and salt, and one or two beaten eggs, and stick pieces of butter thickly over it, and invert a tin pan over it so as to steam it; bake, if small, half an hour; remove the cover a few minutes before it is quite done and let it brown.



**Veal Patties.**

Chop up the veal and some ham, using only one-third ham to two-thirds veal; add powdered crackers and wet with gravy or milk; use hot milk, two tablespoonfuls of butter, and one beaten egg; season well and bake in patty pans; if eaten hot (and most persons prefer them hot), line the pans with puff paste and send them to the table.

**Sweetbreads.**

Parboil the sweetbreads, cut them into slices and dip them in eggs well beaten, then into cracker dust or bread crumbs; season with pepper, salt, chopped parsley, and the grated yellow rind of a lemon. They are served with melted butter or mushroom ketchup. They may be garnished with bacon fried in thin slices.

**Tripe.**

Boil the tripe tender, wipe it dry and drip it in a batter made of eggs, flour, and milk, seasoned with salt; garnish with fried parsley. It may be boiled and cut into small pieces and covered with a jelly made by boiling a few cloves in vinegar.

**Kidneys.**

Skin and parboil some sheep's kidneys, cut them in slices, and fry them in butter for a few minutes, with pepper and salt to taste; mix a tablespoonful of flour with a piece of butter in a saucepan, stir till it begins to color, then add a teacupful of good gravy, and the same quantity of sherry; let this boil five minutes, then add to the kidneys, with a small quantity of parsley, finely minced; make them very hot (but *do not let them boil*) and serve.

**Broiled Cold Meat.**

Cut the cold meat into slices and place them on the gridiron, properly cleansed, and rubbed over with a little butter; put into a hot dish a piece of butter the size of a walnut, and a teaspoonful of ketchup; melt them together, and lay the meat from the gridiron on the gravy made by these ingredients as soon as it is done.

**Broiled Mutton Chops.**

Remove most of the fat from the chops and place them over a clear fire, turning often until done; have a dish hot on the stove and in it put a little hot water, pepper, and salt; as the chops are taken from the fire butter each while hot and dip it back and forth in the water; this will season them well and form a delicious gravy. Serve as hot as possible and have the plates heated before serving to prevent any chill.

**Fried Mutton Chops.**

Trim the chops and season them with salt and pepper; fry them in their own fat or pork fat, turning them frequently; brown a little butter and flour, adding some water, and pour this gravy over the chops. Be careful not to let the chops burn while frying.

**Leg of Mutton with Oysters.**

Parboil the oysters and mix them with parsley, onions, and sweet herbs, boiled and chopped fine, and the yolk of two hard-boiled eggs; cut holes in the leg of mutton and put in the dressing; then tie it up in a cloth and boil for two hours or more, according to its size.

**Boiled Leg of Mutton.**

Cut off the shank and trim the knuckle; boil three hours; when part cooked add a little salt. Serve with sauce, and preferably cut cold; save the water for stock, boiling up the shank well cracked, and the knuckle; mashed turnips are usually served with it.

**Mutton Croquettes.**

Cut the meat from a neck of mutton into pieces about as large as the finger, lard them through with ham bacon; let them simmer in some stock with herbs; when done, take the pieces of meat out, reduce the gravy and strain it over them; cover each piece with good fowl seasonings, wrap it in a slice of bacon, wash over with egg, and stew with bread crumbs, and then bake. This is one of the nicest ways of serving mutton or any other meat.

**Grilled Lamb.**

Put a shoulder of lamb into boiling water, and let it boil four minutes; then place where it may simmer very gently; after half an hour take it out and slash or score it with a sharp knife both ways, an inch apart and deep enough to reach the bone; mix up bread crumbs seasoned with a little parsley, thyme, and marjoram, salt and pepper, and after bruising the yolk of an egg over the meat, sprinkle the bread crumbs upon it; then put it over the fire and broil to a delicate brown. Serve hot and with a sauce.

**Beef Croquettes.**

Chop up finesome cold roast beef, and season it with pepper and salt; mix some bread crumbs with milk or with mashed potatoes and with a little flour on the hands make up the meat and the crumbs into balls; fry in a pan with hot lard or dip it into egg and then into fine pulverized cracker dust. The Croquette should be dropped into hot lard so as to float.

**Beef a la Mode.**

Lard a round of beef with slices of fat bacon dipped in vinegar; roll it up with chopped seasoning of cloves, sage, parsley, thyme, pepper, and green onions; bind close and put it in a kettle; cook slowly for ten or twelve hours, turning when half done; thicken with a heaping table-spoonful of flour added when the fluid is reduced one-half.

**Irish Stew.**

Either beef or mutton may be used; cut it into pieces about an inch square and cover with cold water; allow to two pounds of meat two onions, eight good sized potatoes, two tea-

spoonfuls of salt and a half teaspoonful of pepper; cover and cook for two hours, skimming as it boils up; thicken the gravy with flour stirred smooth. Serve very hot.

**Broiled Beef Steak.**

Select a nice sirloin, porterhouse, or tenderloin steak; remove from it all suet and place it over the fire, not too hot; it requires a glowing fire, without flame or smoke; subdue the flames by sprinkling salt upon the coals; heat the gridiron and rub it with a piece of suet to prevent the meat's sticking; cook as desired and serve very hot in a gravy made of a good-sized piece of butter, some pepper and salt, and a gill of water, mixed well together while hot. Another sauce may be made by placing in a saucepan an ounce of butter, a teaspoonful of very finely chopped onion, a pinch of sweet marjoram if desired, and a teaspoonful of fluid beef, together with a wine-glassful of sherry or Madeira; boil this a few minutes, stirring constantly, and pour it over the meat in a hot dish. Serve at once.

**Dried Beef.**

Slice up the dried beef fine, and stew it in a little water until tender; beat up an egg with a little flour; put a lump of butter to the beef, stir in the egg and flour, and serve on toasted bread with the gravy over it. Milk may be used instead of water.

**Mock Duck.**

Fill a rump steak with a dressing and sew it up; put a few slices of pork or some dressing on top; place it in a pan, into which pour a pint of water, cover tight and let it cook slowly for three hours; then take off the lid and brown quickly. Serve hot.

**Fricassee or Brown Stew.**

Cut the meat into small pieces, and brown these on each side in a little hot fat of beef or of fried pork; cover the meat with warm water when done; thicken the gravy with brown flour seasoned with salt and pepper, and flavored with mace, carrots, and sage. If stew is wanted add any vegetables which are seasonable and agreeable to the taste.

**Pounded Beef.**

Take one pound of cold roast beef and pound it well to a paste; add a saltspoonful of salt, half a spoonful of pepper, a blade of mace, and half a pound of clarified butter; mix together, and pass through a wire sieve; press down in pots, covering the top with butter. In this way beef may be kept until required.

**Beef Omelet.**

Take three pounds of beef chopped fine, three eggs beaten together, six crackers rolled fine, one tablespoonful of salt, one teaspoonful of pepper, and one tablespoonful of melted butter; mix all these ingredients up well, and

make like a loaf of bread; put a little water and bits of butter into the pan; invert another pan over it; baste the omelet occasionally; bake an hour and a quarter, and when cold slice very thin.

**Potted Beef.**

Cook a beef steak, cut off the fat, gristle, and outside pieces; pound to a paste in a mortar; to one pound of beef add a saltspoonful of white pepper, a little cayenne, and grated nut-

meg, a little fresh-made mustard, a table-spoonful of beef gravy, and three ounces of dissolved butter; press it into pots and pour melted butter over it; serve cold.

**Roast Chicken.**

Draw and wash a chicken, and dry with a towel; rub the inside with dry salt; fill with bread filling seasoned with thyme, salt, and pepper; sew up with strong string, crossing the legs and tying down the wings; roast in a moderate oven, having some water in the pan

to baste it with; frequent basting makes it a handsome brown. Make a gravy of the gizzard, heart, and liver, chopped fine, boiled, and thickened with flour. Serve with cranberry sauce and onions boiled in milk. Any fowl may be roasted in this way.

**Fried Chicken.**

After neatly dressing and carving in pieces of proper size, parboil a half hour or longer until tender; take out with fork and place in a fryingpan of melted butter; fry brown by frequent turning to keep from burning. A nice

gravy is made by pouring the broth in which it was boiled into the fryingpan with a thickening of flour and any seasoning preferred. Curled parsley arranged as a garnish adds to the general effect.

**Chicken Panada.**

Skin the chicken and cut it up in joints; take all the meat off the bones and cut up into small pieces; put it in a jar with a little salt; tie it down and set it in a saucepan of boiling

water; it should boil from four to six hours; then pass it through a sieve with a little of the broth. It could be made in a hurry in two hours, but it is better to take longer time.

**Stewed Turkey.**

An old turkey is more tender stewed than when cooked in any other way. Put into a large pot half a pound of bacon cut in slices, a quarter of a pound of knuckle of veal, three sprigs of parsley, two of thyme, six small onions, one carrot cut in small pieces, three cloves, salt and pepper, and then the turkey; add a pint each of broth and white wine;

cover as closely as possible, and simmer gently about two hours and a half; then turn the turkey over and put it back on the fire for another two hours and a half; dish the turkey; strain the sauce; put it back on the fire, and after reducing it to a glaze spread it over the turkey and serve. Some prefer stewed turkey when cold.

**Roast Duck.**

After cleaning the duck, stuff with poultry dressing and roast; if game, half an hour; if tame, one hour; making gravy the same;

serve with currant jelly. Goose is roasted the same way, only taking two hours to roast. Skin off the fat, as it gives a strong taste.

**Birds.**

Small birds are washed and dried, and then broiled or roasted, and served with sauce or

wine gravy or on toast. Reed birds are delicious for the sick.

**Roasted Pigeons.**

Pigeons are roasted with the foot of one leg thrust through a slit made in the other; stuff with the liver, minced with bread crumbs, parsley, pepper and salt, and a little butter;

half an hour's roasting is sufficient, and there should be constant basting while the roasting is in process; serve with toasted bread or with some sauce.



## Quail and Partridges on Toast.

Leave the feet and head on, cross the feet over the breast, and twist the neck round the wing so as to bring the head to the side of the breast, or truss the birds the same as fowls; baste with butter, and when nearly done sprinkle flour over them, and continue basting

until they are browned; toast some bread and place it on a plate; pour over it the contents of the dripping-pan, and serve the birds on it. The sauce may be either plain melted butter or beef gravy. Pheasants, grouse, woodcock, and snipe, may be cooked in the same manner.

## Chicken Croquettes.

Chop cooked chicken fine; season with a little pepper, salt, and butter, mixed with one egg and a little cream; roll the croquettes on a bread board sprinkled with cracker dust until they are shaped like little cylinders; beat an egg light and dip them into it; then roll them

again in the cracker dust; fry in a croquette basket in boiling fat until of a light brown color. The stock of chicken, veal, lamb, or mutton may be used instead of cream to mix them with. Croquettes can be made of any fowl in this way.

## Brown Fricassee.

Cut some chicken into pieces and fry, using only flour to roll the pieces in; three or four slices of salt pork fried brown before the chicken is ready to be put in, may be used; when fried, lay in a saucepan and cover with warm water; add a little salt and pepper, cover, and stew one

hour or longer if required; thicken the gravy with a little flour; this may be made into a "curry" by adding a chopped onion fried in the fat, and a teaspoonful of curry powder; serve with boiled rice, or with some similar dish which may be preferred.

## Venison Steak.

Broil the steak rare and prepare a gravy with butter, pepper, salt, a little flour, and some mushroom ketchup, if the latter is liked; cut the steak into small pieces, and when the

gravy is hot put it in and cover tight; set in the oven for ten minutes, and serve with toast and jelly. The shoulder of venison may be stewed like beef. It should be highly seasoned

## FISH AND SHELLFISH.

## Baked Shad.

Scale, wash, and clean the shad, making an incision only large enough to properly clean it; wash it several times so as to be sure that it is clean; fill it with a stuffing composed of equal parts of mashed potatoes and buttered stale bread cut into fine pieces; season with

salt and pepper to taste; add parsley or any herb in powder; sew it up with strong thread, lay it in a baking-pan with a few little pieces of butter on top, and dredge with flour; add a little water; bake moderately for two hours, basting quite often. Serve hot.

## Broiled or Fried Shad.

Clean and split the shad down the back-bone; have the broiler well rubbed with suet, and broil the fish to a golden brown; salt it when done and spread it with butter; serve hot. It is better if corned a little while before cooking, or sprinkle a little salt on and keep it cool over night; wash off the salt in the

morning before broiling. To fry shad, clean and cut the back-bone out, making *three pieces*; then season with salt and pepper, and dredge with a little flour, and fry in olive oil or any other fat; drain and send to the table hot, the roe and milts may be fried also, and by many persons are preferred to the fish itself.

## Planked Shad.

Scale and split the shad down the back; remove the roe and entrails, wash and dry with a towel; have a heated plank of hickory about two inches thick, and nail the shad on this, with *its back* to the plank; cook one side while placing it before a hot fire of live coals, at an angle of forty-five degrees, bake it a rich brown

color, basting by means of a soft brush, with a *thin* mixture of melted butter and flour; when done serve upon the plank (send the plank to the table). In the meantime parboil the roe, roll it in cracker dust and egg, and fry so as to serve it with the fish. A bottle of Rhine wine will be found to fraternize well with this dish.

**Rock Fish.**

Scale, clean, and wash the fish; cut off the fins, boil in salted water, let it drain for a minute or two, and place on a hot dish; serve with a rich egg sauce poured over it; garnish

with slices of lemon and parsley. Fresh mackerel and sea bass or any other large fish of a similar nature may be cooked the same way.

**Halibut.**

This fish requires careful cleaning and rubbing with salt to remove the slime which exudes from it; make an incision in the back to prevent the skin bursting on the breast, as

the fish swells in boiling; lay it in the kettle, breast upwards; add to the water a handful of salt and a cupful of vinegar. Dish with breast upwards, and serve with any sauce preferred.

**Haddock.**

Let it lay a few hours in salt, then boil briskly for about twenty-five minutes, or less, if the fish is small; the head is esteemed a delicacy. Another excellent way to prepare

haddock is to cut it into pieces, and salt, pepper and dip it into egg and cracker dust; fry slowly and serve while hot. Fresh cod may be done the same way.

**Salmon.**

Salmon should be fresh and if there is more than is required for one meal, it can be slightly salted and kept in a cool place for several days. Wash, clean and scald it; boil in plenty of salt water. It can be cooked whole but is best boiled in slices. Remove instantly

when done, and let it drain across the fish-kettle; serve with any sauce or with plain melted butter. Trout are dressed whole and served in the same manner. Fish, being naturally soft, require a boiling heat to make them firm.

**Pickled Salmon.**

Scald and clean, cut into pieces, and lay them in a kettle with equal quantities of water and vinegar, enough to cover them; put in salt, pepper, and a little mace; when these have boiled enough, drain and lay them on a cloth, put more in the kettle, and boil; continue

until all is done. When it is cold pack the fish and cover it with a pickle; place something heavy upon it to keep it down. The pickle must be poured off occasionally and scalded. Keep out the air by covering always with plenty of pickle.

**Mackerel, Boiled, Fresh, and Salted.**

Clean the fish and boil five minutes; serve with parsley sauce. The fresh fish fried in a little lard is delicious. When salt mackerel

are used they may be broiled or fried, after being well soaked, or they may be boiled before soaking.

**Salt Codfish.**

Soak a piece of fish over night; pour out the water and cover the fish again with lukewarm water; let it stand until cold; then put it in lukewarm water, and let it simmer (but

not boil) for two hours; remove the skin and bone; serve with drawn butter or egg sauce, and with whole boiled potatoes. Fresh Codfish are cooked like Haddock, or other fish.

**Codfish Cakes.**

Take equal quantities of fish and potatoes, shred the fish, and after boiling the potatoes mash them as for table use very smooth; beat

them together with a fork and make them into little balls, and float in hot lard until fried a light brown; place before the fire to drain.

**Salmon Croquettes.**

This is a dainty dish and may be made of fresh fish, boiled and cold, or of canned salmon. The meat must be carefully separated from all the skin and bones, and chopped fine with the juice of half a lemon, a tablespoonful of chopped parsley, a little salt and cayenne pepper; put two ounces of the best butter for each pound of salmon into a saucepan, with a teaspoonful of flour to each ounce of butter, and cook, stirring constantly; add a little stock and a tumbler of cream; boil five or six

minutes, stirring constantly; then mix in the chopped salmon, stirring well; and then stir in rapidly the yolks of four eggs. Continue to evaporate this mixture on the fire, stirring briskly for a few minutes longer; then pour it into a flat dish to get perfectly cold; make into cones, using flour to prevent it from sticking; when finished dip the cones once into eggs beaten up with a little cream, roll them in cracker dust or powdered bread, and fry to a delicate brown in plenty of boiling hot lard.

## Chowder.

Take three pounds of any sort of fresh fish (though fresh cod is best); six large potatoes, two onions, and a half pound of salt pork; fry the pork in thin slices to a light brown; add the onions and brown them; pour the fat into a saucepan, and put a layer of potatoes, a little onion and pork, and a layer of fish cut in small pieces, salting and peppering each layer; just cover with boiling water and boil for half an hour. In the meanwhile boil a pint of

milk, and when at the boiling-point break into it a dozen crackers, and add a heaping tablespoonful of butter; put the chowder in a pan and pour the crackers and milk over it, or lay the crackers in the chowder dry and pour the boiling milk over all; serve in a tureen; three or four tomatoes are sometimes added. Clam chowder is made the same way, with the substitution of one hundred clams for the fish, and the addition of a can of tomatoes.

## Stewed Oysters.

Separate the liquor from the oysters, strain it and put it on the stove, and let it *simmer gently*; when hot add some cream, and then, when that is hot, add the oysters; remove at

once and pour into a hot dish with a little butter, salt and pepper, and serve at once; this can be poured on toast, and many persons prefer it that way.

## Grilled Oysters.

Wash the shells nice and clean and place on a gridiron; as soon as each shell opens slightly insert a knife and remove half of the

shell; season; send to the table piping hot (as can be readily done, for the shells retain the heat), with a little butter and pepper and salt.

## Oyster Patties.

Beard the oysters, and, if large, halve them; put them into a saucepan with a piece of butter rolled in flour, some finely shredded lemon rind, a little pepper, and milk, and a portion of the

liquor from the oysters; stir all together and let it simmer for a few minutes, and then put it into patty pans, which should be ready with a puff paste crust in them. Serve hot or cold.

## Deviled Oysters.

Separate the oysters from their juice, and dust them well with flour; put one ounce of butter for each dozen oysters into a frying pan made boiling hot; put in the oysters, and fry them to a nice brown color; then add the juice

of half a lemon, a saltspoonful of cayenne pepper, half a teaspoonful of mustard, and a little curry powder; stir all together, and serve piping hot. Deviled oysters are too rich for weak stomachs.

## Fried Oysters.

Drain the liquor from the oysters, and then roll each in cracker dust; beat up some fresh eggs, add some liquor of the oyster, and dip them in it; then roll them in cracker dust,

again in egg, and again in cracker dust; have some olive oil boiling hot and float the oysters in it, and fry them to a light brown. Lard or olive butter can be used. Garnish with parsley.

## Oyster Croquettes.

Blanch and drain fifty oysters in a colander, and when they have become cold chop them up very fine; strain the oyster juice through a fine sieve and put it into a saucepan, and boil it down to one half its quantity, taking care it does not scorch; add a half pound of butter, mixed very smoothly with a dessert-spoonful of flour, and stir constantly until it becomes a thickish, smooth sauce; then add a teaspoonful of minced parsley; now add the chopped

oysters, a gill of rich cream, two or three beaten eggs, and a saltspoonful of salt; stir these all together and continue until it is a thick paste; pour it immediately on a large dish, spread it out and set to cool; then, with a little flour on the hands, make up into small pear-shaped cones, dip each one separately into beaten egg and a little oyster juice or milk, then roll in cracker or bread crumbs; give them a second coat; fry in hot lard and garnish with parsley.

## Oyster Fritters.

Drain the juice from one hundred oysters, take six eggs beaten up light, two cupfuls of cracker dust, and one of flour, a little salt and pepper, all added to the juice, or milk enough to make a batter; then add two teaspoonfuls

of baking powder, and oysters; have the lard boiling hot; drop the mixture into it by large tablespoonfuls, and fry to a nice brown. Clams make delicious fritters, and are used in this way very frequently.



## Panned Oysters.

Select large, highly-flavored oysters, those for frying are the best; have a small pan about one inch deep, with a handle; put into the pan one dozen oysters and their *own juice only*; place on a quick fire, and when they begin to

swell they are done; add a little butter and pepper, also salt (if they are not salts); turn out into a *very hot dish*, or they may be eaten from the pan in which they have been cooked while they are steaming hot.

## Oysters and Macaroni.

Butter a dish and sprinkle it well with bread crumbs; put into it a layer of fricasseed oysters, then a layer of macaroni that has been cooked quite tender, then add another

layer of the oysters, and so on until the dish is full; cover the top with bread crumbs, and this with small pats of butter, and brown in a quick oven.

## Oyster Omelet.

Put half a dozen plump, large oysters, in their own juice, into a stewpan on a clear fire; take them off at the first boil, drain them, cut

them in half, and spread a tablespoonful over the omelet, which is prepared according to the recipe already given, just before turning.

## Pickled Oysters.

For one hundred oysters and each pint of juice add one tablespoonful of salt, one of cloves, one of black pepper, and mace, if liked; strain the oysters and wash them well in boiling water, to remove their slime; stir well, strain, and rinse in cold water; now put them into a saucepan with enough water to cover them, let them boil once, and take them out with a

skimmer; to every pint of the strained oyster juice mix one quart of pure vinegar, and add the spices, and when it boils throw in the oysters, and let it simmer; then put into fruit jars and seal at once. They will keep only two or three weeks, and when a jar is opened it should be used at once. They are very nice for a tea or light lunch.

## Fried Eels.

Select nice eels weighing two pounds each or less; skin them and place them either in the oven or on a gridiron for eight minutes, to draw out the fat; split them down the thin part, take out the backbone, cut off the fins, scrape the outside, and cut them into pieces

three inches long; have three ounces of dried crumbs of bread and two well-beaten eggs; dip each piece of eel into the egg and then into the crumbs, and fry in boiling lard over a slow fire till they are a pale yellow color; serve with melted butter or other sauce in a tureen.

## Boiled Lobsters or Crabs.

Be sure that the lobster is alive; if dead, it will not be fit to use; have your water boiling in a large kettle with a little salt in it, and, holding the lobster or crab by the back, drop

it in head foremost—the reason for this being that the animal dies instantly when put in this way; an hour is required to boil it, and the shell turns red when done.

## Baked Clams.

Put on the liquor from twenty-five clams, and when hot skim it, and add a teaspoonful of butter after rubbing a half teaspoonful of flour in it to a cream; stir until it melts, and allow it to become of the consistency of gruel; then, having chopped the clams fine, and re-

jected the tough part, pour them in and let them cook a few minutes only; season with pepper and salt and place in nicely-washed shells, sprinkle with bread crumbs and bake in a quick oven for twenty minutes. Baked clams are a fashionable dish in New England.

## Deviled Clams.

Take fifty clams chopped fine, two ripe tomatoes, one onion, also chopped fine; a little parsley, thyme, sweet marjoram, salt, pepper, and bread crumbs; then add the juice of the clams until the mixture is quite thick; fill the

shells and place a lump of butter on each; cover with cracker dust and bake half an hour. Crabs may be deviled the same way with the sweet marjoram omitted and a little cayenne pepper added.

## Scalloped Oysters.

Take fifty oysters blanched and bearded; strain and boil down the juice as thick as possible and add one quart of cream; rub eight ounces of butter and four tablespoonfuls of flour to a smooth paste with three tablespoonfuls of scalding cream, and add the juice; then season with a teaspoonful of salt, and two salt-spoonfuls of allspice, two of white pepper, and two of mace; pour in the yolks of four well-

beaten eggs and a little cold water, until smooth; then strain the mixture upon the oysters and mix lightly; butter some porcelain scallop-pans, and sprinkle them with bread crumbs, and heap on each one as many oysters with their sauce as it will hold; sprinkle with bread crumbs or cracker dust and set in a moderately hot oven to brown. Serve very hot as soon as done.

## Steamed Oysters.

Scrub the unopened oyster shells till clean; put in a large pot a wire strainer which shall stand about one-third of the depth of the pot from the bottom; place the oysters in it, the round side down; pour in water to one-fourth

the depth of the pot; put on the lid and set over a quick fire, and boil until the oysters open their shells; take out the oysters and and serve them the same as roasted oysters, which they to some degree resemble.

## BREAD AND CAKE.

## Bread.

The general rule for making bread is one quart of wetting—either milk or warm water—to five quarts of flour, and one large cup of yeast; make a sponge of the wetting and yeast with part of the flour; it should be mixed in the evening and will be ready for moulding into loaves the next morning; set it to rise in a warm place in the winter, and in a cool place in summer; mould the sponge into loaves by adding the remaining flour, and knead with the palm of the hand as much as possible; the dough quickly becomes a flat cake; fold it over and keep on kneading not less than twenty minutes or half an hour; make into four loaves, and put them into pans; set them in a warm place to rise; when they have become nearly double in size, place them in the oven to bake; the heat of the oven should be sufficient to brown a teaspoonful of flour in one minute, the

flour being spread on a small plate so that it may have an even heat; loaves of this size will bake in from forty to sixty minutes; then take them from the pans, wrap them in thick cloths kept for the purpose, and stand them tilted up against the pans till cold. *Never lay hot bread on a pine table, as it will sweat and absorb the taste; it should be tilted that the air may pass around it freely.*

## ANOTHER RECIPE.

Take one quart of flour, a little sugar, and a pinch of salt, two teaspoonfuls of some kind of baking powder, and one and a half pints of milk; mix smoothly and rapidly, and turn into a greased pan; bake in a moderate oven forty-five minutes. The sugar can be omitted and water used in place of milk.

## Brown Bread.

Sift into a deep bowl one cup of Indian meal, and two cups of rye flour, a teaspoonful of salt, and one of soda, vary the proportions of rye and cornmeal according to taste; if more rye is used the dough should be stiff; if cornmeal be the greater part it must be softer and requires longer baking; to one pint of hot water add one cup of molasses, and stir until well mixed; make a hole in the

middle of the meal and stir in the molasses and water, beating all till smooth; butter a tin pudding boiler, or a tinpan holding three pints, and put in the mixture; set the boiler into a kettle of boiling water; boil steadily for four hours, keeping the water always at the same level; then take out the boiler, and set it in the oven for fifteen minutes to dry and form a crust; turn out and serve hot.

## Corn Bread.

To a pint of fine Indian meal add shortening about the size of an egg, one teaspoonful of salt, two small teaspoonfuls of cream of tartar, and then milk sufficient to make a batter, and one egg beaten up; dissolve a small tea-

spoonful of soda and stir it in thoroughly; grease the pan well, and bake in a pretty hot oven about one hour. If you use buttermilk, make the same way, but leave out the cream of tartar.

**Graham Bread.**

Make one quart of wheat sponge; pour it into a deep bowl and add a teacupful of brown sugar or molasses, half a teaspoonful of soda dissolved in a little hot water, and a little salt; then sift into it one even quart of graham flour; the mixture should be very stiff; bake in two loaves for an hour or a little more. Graham bread requires a longer time to bake than wheat bread. If no sponge is at hand make as follows:

Take one pint of milk or water (warm), half a cup of sugar or molasses, half a cup of yeast, a little salt, one cup of wheat flour, and two cups of graham; when all are mixed set in a cool place over night (graham bread sours more easily than wheat bread); in the morning stir it well; put it into two deep well-greased pans; let it rise an hour in a warm place, and bake one hour.

**Rye Bread.**

This is made by the same rule as for graham bread, substituting rye for graham flour, but use enough rye to make a dough which can be turned out; use *wheat* flour for the moulding

pan and hands, as rye is very sticky, and knead only long enough to get it into good shape; raise, and bake as in the above rule for graham bread.

**Rice Flour Bread.**

Take one quart of rice flour; wet it with warm water until it becomes a stiff pap; be sure no lumps remain; then add two or three quarts of boiling hot water; stir it until it boils; cool it, and put in one pint of yeast and

a little salt; knead in as much wheat flour as will make it a proper dough for bread; set it by to rise, and when risen add a little more wheat flour; then let it stand in a warm place half an hour, and bake as other bread.

**Rusks.**

Take three pints of flour and rub a quarter of a pound of butter well through it; then add one pint of sugar, a tablespoonful of yeast, and

one pint of warm milk; set it as a sponge, and put in all the ingredients and mix them up together while soft.

**Plain Rolls.**

Allow one pint of bread dough for twelve small rolls, flour the moulding board lightly and knead into the dough butter or lard the size of an egg; cut the dough into round cakes which may be flattened out, and one-half turned over the other; spread a little butter between the folds to make what are called pocket-book

rolls. This same dough is made into French rolls by pressing a knife handle almost through the centre of round balls of it; put the rolls in a well-greased pan an inch apart, and set them to rise an hour and a half before baking; they require more time to rise than large loaves. Bake in a quick oven twenty minutes.

**Parker-House Rolls.**

Take one pint of new milk, two quarts of flour, a little salt, half a cup of lard, one-fourth cup of sugar, one cup of yeast, and half a teaspoonful of soda; stir together to make a

sponge; set it to rise and sponge four times; roll thin, butter and double together like plain rolls; let them rise again and place in a hot oven; bake twenty minutes.

**New York Biscuit.**

Rub into one pound of flour a half pound of butter, three-quarters of a pound of sugar,

and three teaspoonfuls of yeast powder; then mix in a teacupful of milk; bake in gem-pans.

**Soda and Cream of Tartar Biscuit.**

Mix into one quart of flour one teaspoonful of salt, one of soda, and two of cream of tartar, then pass it through a fine sieve; rub a piece of butter or lard the size of an egg in the flour with the hands till perfectly fine; then add

one cup of milk; mix well and roll out quickly; cut into round cakes and bake in a quick oven. They are very light if properly made, but all depends upon the mixing and baking, which should be as rapid as possible.

**Muffins.**

Mix one quart of milk, one egg, one spoonful of butter, two spoonfuls of lard, one-half cup of yeast, and flour enough to make a batter a little thicker than griddle cakes; put to rise over night; bake in the morning in rings.

The following is a simple recipe for the same.

**ANOTHER RECIPE.**

Mix one pint of new milk, four eggs, a little salt, flour enough for batter; bake in muffin rings.



## Sallie Lunn.

Take three cups of flour and sift into it two teaspoonfuls of baking powder, two table-spoonfuls of sugar, two well-beaten eggs, a piece of butter the size of an egg, a pint of sweet milk, and a little salt; mix well and bake in muffin rings.

## Waffles.

Take one pint of new milk, and add three well-beaten eggs; melt a piece of butter the size of an egg and pour it in; mix with one pint of flour a little salt and two teaspoonfuls of baking powder, and add slowly to the milk and eggs, making a thin batter; beat well, and bake at once in a well greased waffle-iron. If sour milk is used, substitute soda for the powder. Sour cream makes delicious waffles. Boiled rice added to the above batter makes rice waffles.

## Breakfast Puffs or Pop-Overs.

Stir together one pint of flour and one pint of milk; beat one egg very light and add it with a little salt; have a set of gem-pans well greased and heating in the oven; put in the batter and bake half an hour in a hot oven. This is a simple, but most delicate breakfast cake. No baking powder or soda must be used.

## Hoe Cake.

Take one quart of cornmeal, one cup of boiling water, one teaspoonful of salt, and one tablespoonful of lard; melt the lard in the water; add the salt, and pour the water on the meal until it becomes a dough; when cool make it into one large or two small cakes, and bake a half hour to a light brown. It should be baked before an open fire on a board.

## Corn Gems with Eggs.

Wet a pint and a half of coarse cornmeal with cold water, making a stiff batter; let it stand over night, and remain on ice when the weather is warm; stir in a well-beaten egg in the morning; add half a teaspoonful of soda dissolved in boiling water, and stir again thoroughly; dip into gem-pans that are well greased and hot, and bake thirty minutes.

## Graham Gems.

Stir into cold water coarse graham flour to make a tolerably stiff batter, not thin enough to settle smooth in a spoon; if too thin or thick they will not be good; add a little salt, beat vigorously, and dip into hot gem-pans of cast iron; if clean the pans need no oiling; bake in a very hot oven for thirty or forty minutes. Fruit of any kind may be added to this batter. Raisins should be partly stewed before being added.

## Buckwheat Cakes.

Take equal quantities of buckwheat, Indian meal, and graham flour, to make one quart; add half a cup of new yeast, a little salt, and enough milk or lukewarm water to make a thick batter; set it in a warm place to rise, and have a well-greased griddle hot, and bake in small cakes. The griddle should be greased each time.

## Common Pancakes.

To one and a half pints of milk add a little salt and the yolks of six eggs well beaten; then mix in slowly about six ounces of flour and some melted butter; then add the whites beaten to a froth; the batter should be of the consistency of thick cream; place a frying-pan on the fire, and when quite hot put into it a little lard or butter; pour in batter (about one-quarter of a teacupful), and spread it around the pan until thin, then fry brown and turn it over and brown again; they may be served in rolls after being spread with preserves; serve immediately, for if allowed to stand they grow heavy.

## Bread Griddle Cakes.

Take pieces of stale bread, soak them in water until soft, drain them, and rub the bread to a pulp; then add two or three beaten eggs and milk enough to make a thick batter; cook them on a hot griddle in small cakes. The egg may be omitted.

**Flannel Cakes.**

Take a pint bowl two-thirds full of Indian meal and mix with scalding water; stir in a piece of lard or butter the size of two walnuts; then put in cold water so as not to scald the flour; then mix in a pint of flour and, if needed, water enough to make it of the consistency of batter cakes; add two spoonfuls of yeast, and set it to rise. Bake on a griddle.

Many cooks make flannel cakes as follows:

**ANOTHER RECIPE.**

Put two ounces of butter into a pint of hot milk, then add a pint of cold milk, four beaten eggs, a teaspoonful of salt, two tablespoonfuls of yeast, and enough flour to make a stiff batter; let it rise and fry on a griddle.

**Indian Griddle Cakes.**

Take one pint of Indian meal, one cup of flour, a tablespoonful of molasses, a teaspoonful of salaratus, a little salt and ginger, and suffi-

cient sour milk to make a stiff batter, bake on the griddle. This is the recipe given by Jennie June.

**Rye Griddle Cakes.**

Mix one quart of sweet milk, two eggs, one-half teaspoonful of salaratus, a little salt, and

enough rye flour to make a batter; baking powder may be used instead of salaratus.

**Rice Griddle Cakes.**

Take one cup of rice boiled very soft and mashed fine, a pint of milk, and two or three eggs, a little flour stirred in, and a teaspoonful

of baking powder; have ready a hot griddle and bake in small cakes, allowing them to brown nicely, but not to burn.

**Pound Cakes.**

Take one pound of sugar, one pound of butter; beat well together until very light; add ten well-beaten eggs; beat well again; add one

pound of flour; mix until smooth, and bake in moderate heat; flavor with rose. A hot oven is required if baked in small tins.

**Gold Cake.**

Mix two cups of sugar; two and a half cups of flour; three-fourth of a cup of milk; a half cup of butter; the yolk of eight eggs, and

three teaspoonfuls of baking powder. Bake carefully, in a moderately hot oven, being careful not to burn.

**Lady Cake.**

Make the same as gold cake, but using the whites of the eggs only instead of the yolks.

**Temperance Cake.**

Take two pounds of flour, three-quarters of a pound of butter or lard, one pound of sugar, one grated nutmeg, six eggs and four teaspoonfuls of baking powder. Rub the flower, butter

and sugar together; then add the eggs, well beaten. Roll and cut into small cakes and bake in a quick oven, watching to see that it does not burn.

**Jelly Cake.**

Beat to a cream one pound of butter; add one pound of sugar; then add the yolks of ten eggs and three-quarters of a pound of flour,

and finally add the whites of the eggs, beaten to a froth. Bake in shallow tins, and put jelly between each two layers. Use any flavor.

**New York Cake.**

Mix one pound of flour, half a pound of pulverized sugar, a quarter of a cup of butter,

one gill of cream, and three teaspoonfuls of baking powder with suitable spices.

**Cream Cake.**

Mix four cups of flour, three cups of sugar, one cup of butter, one cup of sweet cream, five

eggs and four teaspoonfuls of baking powder. Bake in a quick oven.

**Cup Cakes.**

Take two cups of sugar, three-quarters of a cup of butter, three cups of flour, one cup of milk, three eggs, one teaspoonful of soda, and

two teaspoonfuls of cream of tartar; bake in a well greased pan, taking care to keep the oven at a moderate even heat.

**Molasses Cake.**

Mix three cups of flour, one cup of sugar, one cup of molasses, one cup of butter, one cup of sweet milk, a teaspoonful of soda, three eggs, and a little cinnamon and ginger.

**ANOTHER RECIPE.**

Take one cup of molasses, one cup of hot water with a teaspoonful of soda in it, a tablespoonful of butter or lard, a teaspoonful of ginger, and two cups of flour; if lard is used, add a little salt; put the flour in a dish, make a hole and pour the molasses into it; then mix the butter melted into the molasses, and then

the ginger; stir all together, and add the hot water with the soda in it, stir quickly and place at once in a moderate oven.

**ANOTHER RECIPE.**

Take two cups of molasses, half a cup of butter, one cup of water, and a teaspoonful of soda dissolved in hot water; beat the molasses and butter together, put the soda in this, then the water, a teaspoonful of cinnamon and ginger, and flour enough to make a soft dough; warm the butter or lard, so that it will readily mix with the molasses.

**Ginger Cakes.**

Take two cups of molasses, shortening the size of an egg, one teaspoonful of soda, two

tablespoonfuls of ginger, and one cup of hot water; add enough flour to make it stiff.

**Remington Cake.**

Mix four well-beaten eggs, four cups of flour, two cups of sugar, half a cup of milk, half a

cup of butter, and three and a half cups of baking powder.

**Ice-Cream Cake.**

Mix two cups of sugar, three cups of flour, one cup of milk, a tablespoonful of butter, the whites of three eggs, and two teaspoonfuls of baking powder; divide and bake in two cakes.

For icing, which adds very much to the attractive appearance, flavor the whites of two eggs with vanilla, and beat them up, adding gradually pulverized sugar until stiff.

**Coffee Cake.**

Mix five cups of flour, one cup of made coffee, one cup of sugar, half a cup of molasses, one cup of butter, and a teaspoonful of cloves;

add raisins or currants, if they are agreeable to the taste and four teaspoonfuls of baking powder.

**Dutch Cake.**

Take three pounds of flour, one pound of sugar, half a pound of butter, half a pound of lard, half a pound of raisins, one pound of currants, a quarter of a pound of citron, three eggs, one teaspoonful of cinnamon, one grated

nutmeg, one quart of milk, and two cups of yeast; set a sponge of part of the flour with the other ingredients; and then add the remainder of the flour. This is a wholesome cake suitable for evening use.

**Fancy Cake.**

Take one cup of pulverized sugar, two eggs, half a cup of melted butter, half a cup of sweet milk, one and a half cups of flour, and two teaspoonfuls of yeast powder; beat the butter and sugar to a cream, and add the eggs well beaten; beat again, add one cup of flour and

the milk, and add the remainder of the flour and the yeast powder, rubbed together; again beat well and place in a quick oven for a few minutes, then bake slowly one hour. This quantity will make two small cakes or one large cake.

**Fruit Cake.**

Mix three cups of sugar, six cups of flour, one cup of milk, two cups of butter, seven eggs, three teaspoonfuls of baking powder, one of salt, one pound of raisins, half a pound of

citron, half a pound of currants, half a pound of figs, three teaspoonfuls of cinnamon, half a nutmeg. This will make three cakes; bake one and a half hours.

**Macaroons.**

Scald and peel a pound of almonds; let them remain awhile in the water; then dry them, and mash them together; moisten them in the white of an egg to prevent their turning into

oil; then take an equal quantity of powdered sugar, and the whites of four eggs; mix together, shape into small cakes and bake on tins, in a moderate oven.



**Crullers.**

Mix one cup of butter, two cups of sugar, one cup of milk, one teaspoonful of soda, three eggs, and flour sufficient to roll out with ease; fry them floating in lard; flavor with nutmeg.

**Cocoanut Cake.**

Mix one quart of flour, one pound of sugar, three eggs, one pint of milk, a piece of butter the size of two eggs, two tablespoonfuls of baking powder, a little salt, and one small cocoanut grated; flavor to suit the taste; bake in a moderate oven.

**Snow-Flake Cake.**

Mix one cup of butter, two cups of sugar, one cup of corn starch, two cups of flour, the whites of seven eggs, a scant cup of cream, and two teaspoonfuls of baking powder; beat butter and sugar together; add the cornstarch and cream, and then the rest; beat the whites of the eggs to a froth, and then add them to the mixture after everything else; flavor with a few drops of bitter almond, or flavoring may be omitted entirely.

**Sponge Cake.**

Take six eggs, one and a half cups of sugar, one cup of flour, and one teaspoonful of baking powder; flavor with almond; beat the whites separately; add the yolks and sugar, and the juice of one lemon or a tablespoonful of vinegar; then add the yeast and flour, and finally the whites of the eggs; stir as little as possible.

**Marble Cake.**

For the White Portion:—Use the whites of seven eggs, two cups of white sugar, one cup of butter, three cups of flour, and half a cup of sweet milk; flavor with lemon or vanilla, and three teaspoonfuls of baking powder; cream the butter and sugar first; then add the white of the eggs, well beaten with the flour and yeast powder.

For the Dark Portion:—Mix the yolks of seven eggs with one cup of butter, one of molasses, two cups of brown sugar, two teaspoonfuls of cinnamon, one cup of milk, and five cups of flour; put each part in turn in a cake pan; bake it in a moderate oven; allspices, nutmeg and cloves can be used if desired. The quantities given will make two large cakes.

**Chocolate Cake.**

Mix two cups of sugar, one cup of butter, one cup of milk, the yolks of five eggs, and the whites of two eggs; mix two teaspoonfuls of yeast powder with three and a half cups of flour while dry; cream the sugar and butter, and add the rest; bake in jelly tins; prepare a mixture of the whites of three eggs, one and a half cups of pulverized sugar, three tablespoonfuls of grated chocolate, one teaspoonful of vanilla, all these ingredients being thoroughly mixed together; spread this between each two layers of the cake, and on top of the whole.

**Doughnuts.**

Mix one pint of milk, one teacup of melted lard, two teacups of brown sugar, one cup of yeast, three eggs, two teaspoonfuls of cinnamon, and one of salt; set a sponge and let it rise; then mix in flour enough to make a dough and set it to rise again; then knead and roll out; cut into cakes and fry in hot lard by letting them float in it.

**Icing.**

To ice a large cake, put eight ounces of powdered sugar into a deep dish with four spoonfuls of rice water and the whites of two eggs; beating and straining it; then whisk it well and it is ready to be put in the cake; set it in the oven a few minutes to harden.

**Chocolate Icing.**

Take a cup of milk, and a quarter of a pound of grated chocolate, one cup of powdered sugar, scald the milk and chocolate; and add the sugar, and pour this on the whites of two eggs after they are well beaten, and proceed as for ordinary icing.

## SAUCES AND SALADS.

## Lobster Salad.

Boil the lobster about half an hour; when it is cold take it from the shell, being careful to take out the vein in the back; to two heads of salad allow six pounds of lobster, one cup of melted butter, two tablespoonfuls of mustard mixed with a little vinegar and salt and pepper

to taste; chop them up together and spread on a flat dish; then beat six eggs and mix with half a pint of vinegar; put this on the stove to thicken, stir it constantly, and when it has become cold spread it over the lobster dressing; the sauce may be served separately.

## Salmon Mayonnaise.

Carefully remove all the skin and bones from a pound of boiled salmon, draining away all the liquid; cut it in small pieces and season with two tablespoonfuls of vinegar, half a small onion minced fine, and half a tea-

spoonful of salt and pepper; cover the bottom of the salad dish with crisp lettuce-leaves, lay the salmon on it, and pour on the sauce. *Lobster* may be substituted for the salmon, and prepared the same way.

## Mayonnaise Sauce.

Take one yolk of a raw egg, some salt, pepper, and a little raw mustard; mix these together with a silver fork in a large plate; add salad oil slowly, and in the quantity used be guided by the taste; mix by stirring one

way until quite thick and smooth; then add vinegar enough to thin it a little; if there is any difficulty in getting the oil to mix, add a few drops of vinegar from time to time and keep stirring.

## Caper Sauce.

Pound a tablespoonful of fresh-boiled shrimps and a tablespoonful of capers; knead together three ounces of butter and a tablespoonful of baked flour, and stir them into the

third of a pint of boiling water; add the pounded capers and shrimps, and a dessert-spoonful of whole capers; boil for ten minutes, and serve.

## White Sauce.

Boil well over the fire half a pint of milk, a quarter of a pint of stock of a light color; season with salt, and thicken with some flour

and butter; mix the flour with milk for white sauce. The yolk of an egg may be used if desired.

## Rice Sauce.

Soak a quarter of a pound of rice in a pint of milk, with a little pepper, an onion, and a little salt; when it is quite tender, remove the

spice, rub it through a sieve into a stewpan, and boil it; if too thick add a small quantity of cream or milk. This is good for game.

## Egg Sauce.

Mince two or three hard-boiled eggs, and

mix them thoroughly together in white sauce.

## Celery Sauce.

Cut some celery into inch lengths; fry it in butter until it begins to be tender; add a teaspoonful of flour, which may be allowed to

brown, and half a pint of good broth or beef gravy; season with cayenne, or black pepper, or other seasoning, as desired.

## Drawn Butter.

Rub two teaspoonfuls of flour into a quarter of a pound of butter; add five tablespoonfuls of cold water, or the water any vegetable, such as asparagus, has been cooked in; let it simmer

until smooth. If for fish, chopped boiled eggs and capers may be put in. If for boiled fowl, oysters may be put in while it is melting, and cooked through while it is simmering.

## Parsley Sauce.

Wash a bunch of parsley in salted water, dip it twice into boiling water, and chop the leaves quite fine; knead a quarter of a pound of butter with a tablespoonful of baked flour, and stir it into the third of a pint of the water

that a fowl has been cooked in; let it simmer five minutes; stir in a dessert-spoonful of the chopped parsley; serve with fowl or fish. If with boiled fish, use in making the sauce the water the fish was boiled in.

**Hard Sauce.**

Beat together half a cup of butter and a cup of sugar, and add a tablespoonful of wine if desired; pile lightly on a dish, grate nutmeg over the top, and set in the cool until used.

**Mint Sauce.**

Look over and strip off the leaves of mint, and cut them as fine as possible with a sharp knife; use only the tender tips; to a cupful of chopped mint allow an equal quantity of sugar, and half a cup of good vinegar. It should stand an hour before using.

**Dressing without Oil.**

Cream a small cup of butter, and stir into it the yolks of three eggs; mix together one teaspoonful of mustard, one teaspoonful of salt, and a quarter of a saltspoonful of cayenne pepper, and add it to the butter and egg; stir in slowly one cup of cream, and add the juice of one lemon and half a cup of vinegar. This makes a very nice dressing.

**Salad Dressing.**

Boil three fresh eggs for ten minutes; when cold rub the yolks to a paste with a little pepper and salt, and teaspoonful of mustard, and a little sugar; mix in the beaten yolk of one egg; add by degrees four tablespoonfuls of salad (Lucca) oil, and, drop by drop, two teaspoonfuls of tarragon vinegar, and one tablespoonful and a half of vinegar; serve at once.

**Chicken Salad.**

Take two chickens, weighing six pounds, two bunches of celery; boil the chickens in very little water; cut into large pieces; dry the celery without washing; take two yolks of hard-boiled eggs, the yolk of one raw egg, and mix them together with one teaspoonful of dry mustard; add slowly half a bottle of oil, the juice of one lemon, two tablespoonfuls of vinegar, a teaspoonful of salt, and a little red pepper; put in a cold place just before using; mix it through the chicken; also two hard-boiled eggs cut fine, one tablespoonful of capers, and six olives cut fine; save a little dressing for the top.

**Potato Salad.**

Slice some fresh-boiled potatoes or some cold potatoes; dress them with oil, vinegar, salt, and pepper, precisely like any other salad, adding a little onion and parsley chopped fine. Use cream or melted butter if oil is not liked.

**Hotch-Potch.**

Take some green tomatoes, cabbage, and cucumbers, pint of each, half a pint of onions; chop all up very fine, salt well; let them stand one night, after which strain through a sieve, and add pepper, horse radish, white mustard seed, and half a pint of sugar; mix all up together well, fill the jar, and cover it entirely with vinegar.

**Tomato Salad.**

Take ripe tomatoes and cut them into thin slices; sprinkle over them a small quantity of finely-chopped green onions; add salt, pepper, vinegar, and oil, if liked. The oil should be in the proportion of three tablespoonfuls to one of vinegar.

**Genoa Sauce.**

Clean and bone four anchovies; put them into a mortar with a tablespoonful of capers, a quarter of a clove of garlic, a tablespoonful of curry powder, a little mustard, and pound till quite smooth; moisten with a wine-glassful of marsala, a wine-glassful of the caper vinegar, and three wine-glassfuls of cold water; put this into a saucepan and boil up; knead a tablespoonful of baked flour with a quarter of a pound of butter; skim the sauce, stir in the thickening, boil fast for ten minutes, strain, and serve.

**Anchovy Sauce.**

Wash four anchovies in hot water, scrape them, and take out the bones; pound the fish to a smooth paste; mix with it a quarter of a grain of cayenne, the strained juice of half a lemon, and the third of a pint of cold water; put it into a saucepan, boil up, and strain; knead together four ounces of butter and a tablespoonful of baked flour, and stir it into the sauce; boil for ten minutes; add one tablespoonful of good cream, and serve at once.



**Cucumber Sauce.**

Pare and slice some cucumbers, and stew them till reduced to a pulp in a little stock seasoned with salt, black and cayenne pepper; pass it through a fine sieve, and rewarm it.

**Horse-Radish Sauce.**

Mix finely scraped or grated horse radish with vinegar and a little salt. Some cream may be added if desired, and also mustard; but with *good* horse radish the sauce will be pungent enough without this last addition. Horse radish is a fine sauce with roast beef.

**A Good Sauce.**

This should go with plain fruit puddings. It is made by mixing one cup of brown sugar, one cup of the best molasses, half a cup of butter, and one large teaspoonful of flour; add the juice and grated rind of one lemon, half a nutmeg grated, and half a teaspoonful of cloves and cinnamon; when these are all stirred together, add a teacupful of boiling water; stir it constantly, put it into a saucepan, and let it boil until clear.

**Champagne Sauce.**

Cut two ounces of the best butter into little bits; put it into a very clean saucepan with a heaping teaspoonful of flour, and two table-spoonfuls of cream or sweet milk; when these are thoroughly mixed over the fire, add half a pint of champagne, and heat again.

**Apple Sauce.**

Pare, core, and slice very thin half a dozen juicy apples, and the rind of a lemon, and cook them till tender; beat the apples to a smooth pulp and remove the lemon peel; add a little butter, sugar, and a little grated nutmeg.

**Winter Salad.**

Mix equal proportions of celery, boiled beet-root, raw white cabbage, and cold fowl or rabbit, all chopped fine, together; dress with mayonnaise sauce, and serve with a garnish of lettuce leaves. This is a delightful salad for persons with weak digestive organs. For very delicate persons omit the cabbage, as it is not very easily digested.

**Water-Cress Salad.**

Wash the cress and drain it well; chop a green onion, two radishes, one spoonful of grated horse radish, and a few leaves of lettuce; season with a little salt and pepper, and plenty of oil and vinegar. This makes a crisp, delightful salad for table use.

**VEGETABLES.****Mashed Potatoes.**

Boil the potatoes, after peeling them and taking out the spots; let them lie a while in cold water; then put them on the stove in a saucepan with lukewarm water; when dry and mealy drain off the water and mash them fine with a potato-masher; add a small bit of butter, a little milk, and salt to taste; then beat to a foam with a fork; heap *lightly* in a dish, and serve at once. They should be cooked quickly. *Never brown* them in the oven.

**Baked Potatoes.**

Wash the potatoes carefully and bake in the skin; it will require an hour to bake large ones. They should be eaten with salt the moment they are done. They may be peeled and baked under meat of any kind; they are delicious this way. They should be basted once or twice with the drippings. Sweet potatoes may be roasted the same way.

**Potato Croquettes.**

Mash some fresh-boiled potatoes, and add a little mace or nutmeg, cayenne pepper, and one beaten egg; make into little balls or rolls, and roll in egg and crumbs or cracker dust; fry in boiling lard; drain on brown paper, or before the fire.

**Potato Chips.**

Wash and peel the potatoes, and cut them into thin shavings; have ready boiling fat, and drop them into it; when done to a light brown

drain them over or before the fire, and sprinkle fine salt over them; keep them crisp and serve hot.

**Scalloped Potatoes.**

Slice half a dish of cold boiled potatoes very thin; add half a pint of milk to them and four ounces of butter; cut into pieces, fill

up the dish with bread crumbs or cracker dust, and about an ounce more of butter; add a little pepper and salt, and bake until brown.

**Potato Cakes.**

Take some mashed potatoes and mix a little flour with them; then make them into

little patties and fry them over a hot fire until they are brown.

**Potatoes a la Creme.**

Put two ounces of butter into a saucepan with a dessert-spoonful of flour, and some parsley and scallions, both chopped fine; salt and pepper to taste; mix together and add a little

cream, and set on the fire, stirring constantly until it boils; cut the cold boiled potatoes into slices and put them into the saucepan with the mixture; boil again, and serve very hot.

**Fried Raw Potatoes.**

Peel and slice the potatoes into very thin slices; put them into cold water for a little while; dry with a towel, and put them into a frying-pan with a little butter or lard, salt and

pepper; cover down, and every little while turn them; when they are tender and a nice rich brown they are done. The grease should be drained from them when sent to the table.

**Lyonnaise Potatoes.**

Slice six cold boiled potatoes, chop up very fine an onion and a little parsley, enough to fill a teaspoon; put a tablespoonful of butter into a frying-pan, and fry the onion to a light brown; then add the potatoes, and fry them

also to a light brown, turning them often; put them into a hot dish, stirring in the minced parsley, and pouring over them any butter that may be left in the pan. Potatoes prepared in this way are liked by almost everyone.

**Carrots and Parsnips.**

These should be washed and scraped, and boiled like turnips; young ones should be served whole, and large ones cut into quarters lengthwise; boil them tender; season with salt

and pepper, and plain melted butter poured over them. Parsnips can be mashed or fried after being boiled. Beets can be used the same way, but they should not be scraped.

**Cauliflower.**

Wash and trim the cauliflower, and boil it in a bag; when tender break it into pieces; place part of them in a dish, cover with butter, bread crumbs, and a little grated cheese; then

add more cauliflower, and so on until the dish is full; the top should be covered with bread crumbs, cheese, and butter; the last should be plentifully applied; bake to a golden brown.

**Spinach.**

Pick off the stem of each spinach leaf and avoid using that which is old or yellow; wash it in several waters and put it into a quart of boiling water with a little salt, press it down,

and boil it rapidly for ten or twelve minutes; drain it through a sieve; place it in a dish and send it to the table to be eaten with vinegar, hard-boiled egg and mustard.

**Green Peas.**

The peas should be young, freshly gathered and freshly shelled; put them into lukewarm water and boil them rapidly; when they are

tender put in a little salt and pepper, and serve with melted butter. Sugar and a sprig of mint may be added while cooking, if desired.

**Asparagus.**

Cut off the dry ends and scrape off the outer skin until you reach the tender part, or use very young asparagus; tie it up in a fine cloth; put it into plenty of boiling water, add-

ing a little salt after it has boiled awhile; when done serve on nicely toasted bread, covering the whole with drawn butter. The toast may be omitted and vinegar may be used.

**Mushrooms.**

Clean and trim off the roots of the mushrooms and dip them into melted butter; roll them in cracker dust and brown them in a quick oven; or cut them into quarters, wash them in several waters, and fry them slowly in butter with a little parsley, salt and pepper.

**Hominy.**

Put half a pound of hominy to soak over night, or put it to cook over a slow fire; then drain off the water and add a pint of milk. It makes a nice dish.

**Haricot Beans.**

Put a quart of beans into one gallon of water and let them simmer slowly; drain them when cooked, and put them into a stewpan with a little salt, pepper, parsley, butter, and lemon juice; place the whole over the fire a few minutes; stir well and serve.

**Baked Egg Plant.**

Peel the egg plant and cut out a piece from the top; dig out the centre, thus removing the seeds; fill the cavity with a dressing like that for ducks, and replace the top piece; bake an hour, basting with a spoonful of butter melted in a cup of hot water, and dredging with flour after each basting. It should be served as soon as possible after it is prepared.

**Egg Plant Fritters.**

Peel the egg plant and take out the seeds; boil it in well-salted water for an hour; mash fine and press all the water off through a coarse cloth, and mix in a fritter batter and fry.

**Macaroni.**

Never wash macaroni. Break it into lengths of three or four inches and throw them into boiling water, allowing a quarter of a pound for every three or four persons; boil for half an hour, and just before it is done put in a little salt, and drain off the water. It may be served plain with tomato sauce, or with drawn butter. It may be baked with milk or grated cheese.

**Stewed Tomatoes.**

Scald some firm tomatoes and peel off the skin; place in a stewpan and cook slowly with a little water; when tender whip them fine, and season with butter, salt and pepper, and a little flour or corn-starch thickening; serve while hot.

**Baked and Stuffed Tomatoes.**

Select firm, ripe tomatoes and cut off a thin slice from the stem end; remove the green core and fill them with an onion chopped fine, a small piece of butter, pepper, salt, and a teaspoonful of cracker dust, or bread crumbs; arrange them in a baking-pan; add a little water, and bake in a slow oven; serve them hot in the pan or a warmed dish.

**String Beans.**

Cut off the ends of the beans and pull off the tough strings; cut them into pieces; put them on in boiling water, with a little salt and carbonate of soda, to preserve their color, and boil them until tender; drain them and place them in a dish with a little salt, pepper, and butter. Some persons like a little vinegar with them.

**Lima Beans.**

Shell and wash the beans, and if old, skin them; put them on to cook in boiling water, and when partly cooked add a little salt; drain them, and season with salt, pepper, and a piece of butter; serve them hot in a covered dish.

**Green Corn.**

Husk two dozen ears of corn and remove all the silk, slightly cutting off the edge of the kernels with a sharp knife, and *scraping* the remainder; place in a pot with two cupfuls of milk, and cook slowly where there is no danger of burning; when ready for the table thin with a little more milk, and season in the dish with salt, pepper, and butter to taste.

The following is a common way of cooking corn:

**ANOTHER RECIPE.**

Strip off all the husks except two or three of the tender inner leaves, and clean carefully; then boil on the ear until tender, twelve to fifteen minutes being the time required for young corn; serve hot after removing the leaves.



**Corn Fritters.**

Take half a dozen ears of corn and free them of all the silk; grate the corn from the cobs, scraping them to get it all off; beat up three eggs very light and add it to the grated corn, then a gill of milk and two tablespoonfuls of

flour, salt to taste, and half a teaspoonful of baking powder; put a little lard into a pan, and when hot allow a tablespoonful for each fritter and fry brown; do not have the lard too hot; serve immediately.

**Beets.**

Wash the beets, but do not peel or even prick them, as the *color* and *sweetness* would be lost; put them in boiling water; young beets will cook in two hours; old ones require five or

six hours to cook well; peel them with the hand and cut them into thin slices, putting butter, salt, and pepper on each slice. When for a pickle, put them into vinegar and a little salt.

**Cabbage.**

Wash and cut all the coarse sticks from each outside leaf; cut the head into quarters and boil an hour, or until tender; drain and

serve as nearly whole as possible. Corned beef or ham, when cooked with it, give it a nice flavor. Serve with vinegar or a vegetable sauce.

**Squash.**

Peel a spring squash, take out the seeds and core, and cut it into pieces and put it on to boil in a little water; when tender press the

water off through a coarse cloth, and then mash it, adding a spoonful of cream, a little butter, pepper and salt to taste; keep hot till used.

**Boiled Onions.**

Peel the onions and put them on to boil in boiling water; when they are tender pour the water off; add a little butter, pepper and

salt to taste, and a little milk; boil them up again, and send to the table hot. They are nice served with turkey or chicken.

**Dandelion.**

Take the young leaves before the plants blossom or while in bud; wash them clean, and boil them in salted water. They are nice

served like spinach. The dandelion is considered very healthy, and the slight bitterness is relished by most persons.

**Succotash.**

Cut the corn from the cobs of half a dozen ears and cook a little while; then add a pint of lima beans (which are best), or any green bean, and boil an hour in a quart of boiling

water, with a little salt and pepper; let the water boil away until only a little remains; then add some milk; season with butter, and serve in a hot dish.

**Boiled Rice.**

Take a cup of rice, wash it, and put it into a boiler; cover it with water and cook fifteen minutes, stirring it if it is likely to stick to the boiler, adding a little salt; then drain, put

into a colander, cover again, and steam fifteen minutes. Rice cooked in this way will be white, the grains will swell to their full size, and will be dry and perfectly tender.

**DESSERTS AND PUDDINGS.****Rice Pudding.**

Take a cupful of rice, put it into a pudding-pan with two quarts of the best milk, half a cup of sugar, a little pinch of salt, and half a nutmeg grated over the top; place it in a moderate oven, and as soon as it is brown on top stir it in, stirring the rice up from the

bottom; repeat this several times, having it brown each time, but *not burnt*, and when the rice is tender, and the milk reduced to one quart, add a little piece of butter, and brown again on top; remove as soon as brown, and set away to cool.

**Apple and Rice Pudding.**

Take some rice, and milk enough to boil it soft; add a little sugar, and some lemon peel, and cinnamon; place it in a double boiler and let it stand over thirty minutes; make some apple sauce, and when the rice is done

turn it out into a dish; hollow out the centre and fill it with the apple sauce; beat the whites of three eggs to a froth, and cover the apples with it; sift pulverized sugar over the top and brown it a little in the oven; then serve.

**Custard.**

Take a quart of new milk and six ounces of sugar; add eight well-beaten eggs and a

little salt; flavor to taste, and fill cups with the custard and bake them.

**Custard Cream.**

Take one pint of cream and five eggs well beaten, five ounces of sugar, and a little grated nutmeg; mix all together; place on the fire and stir constantly until it thickens, then remove

it from the fire and flavor with pure extract of vanilla; put it in an ice-cream freezer and freeze it. The same mixture is used to fill cream puffs with.

**Chocolate Cream Custard.**

Scrape a quarter of a pound of chocolate and put it in a teacupful of water boiling hot; let it remain on the fire until dissolved; then add a little sugar; beat six or eight eggs light and save the whites of two; stir by degrees

into a quart of milk alternately with the chocolate and three tablespoonfuls of pulverized sugar; flavor with vanilla; and bake ten minutes in cups. This makes a most delicious pudding.

**Apple Custard.**

Take sour apples, peel, wash, and cover them, and cook them in half a cupful of water until a little tender; then take them out, place

them in a deep dish, and pour over them the plain custard mixture; then bake for half an hour.

**Arrowroot Pudding.**

Beat up the yolks of two eggs, boil one-third of a pint of milk with a little sugar; mix a dessert-spoonful of arrowroot with a little cold milk until it forms a paste, and pour it into the

boiling milk; when nearly cold beat in the eggs; put it into a basin, and boil it quickly for twenty minutes or bake it for half an hour, taking care not to let it burn.

**Sago Pudding.**

Soak two tablespoonfuls of sago with a little hot milk in a covered basin until soft; add a little grated nutmeg or lemon peel, sugar to

taste, and a well-beaten egg; beat all together until thoroughly mixed; butter some cups and pour the pudding into them and boil it.

**Plain Sago.**

Put a tablespoonful of sago into a saucepan with half a pint of hot water; sweeten to taste, and, if desired, add a glass of port wine; stir it

on the fire for a quarter of an hour; serve in a cup or glass. This is a wholesome and nutritious food.

**Arrowroot Blanc-Mange.**

Mix three tablespoonfuls of arrowroot with one tablespoonful of milk; boil one pint and a half of new milk, sweeten it, and flavor to taste; pour it over the moistened arrowroot

and mix them well; put it over a slow fire until it is thoroughly cooked and thickened, stirring all the time; do not let it burn; pour into a mould, and let it stand till next day.

**Tapioca Blanc-Mange.**

Soak half a pound of tapioca in a pint of milk until a little soft; then boil until tender, adding sugar to taste, and shape it in a mould; turn it out and pour a little cream around it,

jotted with jelly or some kind of jam. The former may be omitted, and lemon or almond may be used. Both ways it is very nice and much relished by the sick.

**Tapioca Pudding.**

Wash the tapioca and soak it in a quart of milk for two hours, setting it on the back of the stove to soak; beat up three eggs and one cup of sugar together, saving the whites for a

meringue, if liked; melt a tablespoonful of butter, add a little salt, and stir into the milk; bake half an hour, or until it is nicely browned on top.

**Tapioca Cream.**

Take one teacupful of tapioca washed and soaked over night in one pint of warm water; add a little salt and a quart of milk in the morning, and boil in a double boiler for two hours; just before it is done add a little butter,

a teaspoonful of vanilla, and three beaten eggs with a cup of sugar; beat the whites of two eggs separately, add a little pulverized sugar, and cover over the top; brown in the oven only a few minutes.

**Bread Pudding.**

Sweeten one quart of milk with a cup of sugar; a little grated nutmeg and a little salt; add three well-beaten eggs; cut the stale bread into slices and butter it, lay as many pieces on

the top as there is room for, and bake it in a pudding-pan; serve a little warm or cold. Raisins may be added, and must be parboiled before.

**Corn-Starch Pudding.**

Take two quarts of milk sweetened with one cup of sugar, place it in a double boiler, and when the milk boils have ready four table-spoonfuls of corn starch wet with milk and stir it in; keep stirring so that it does not go in lumps; let it cook a while; then add two or

three well-beaten eggs, stirring again until it sets; remove from the fire and flavor with vanilla before it cools; cover the top with a meringue and place it in the oven to brown a few minutes. It can be made without eggs if desired.

**Oatmeal Pudding.**

Mix two ounces of fine Scotch oatmeal in a quarter of a pint of milk, add to it a pint of boiling milk, sweeten to taste, and stir over the fire for ten minutes; then put in two ounces of sifted bread crumbs: stir until the mixture

is stiff, then add one ounce of shred suet and one well-beaten egg; add a little flavoring or grated nutmeg; put the pudding into a buttered dish and bake slowly for an hour. It may be served hot or cold.

**Cornmeal Pudding.**

Stir one cup of cornmeal, a teaspoonful of salt, and one cup of molasses together; boil some milk and add the mixture slowly; butter

a pudding-dish and pour the pudding in it; set it in the oven and pour one cup of uncooked milk on top; bake three hours in a slow oven.

**Bread and Butter Pudding.**

Put in a pudding pan a layer of bread crumbs and a layer of tart apples pared, cored, and sliced thin; thus alternate until the dish is nearly full; dissolve a cup of sugar and one teaspoonful of ground cinnamon in a pint of

boiling water, and pour over the layers; let it stand until the crumbs swell; then put in the oven and bake three-quarters of an hour until brown. Serve with a liquid sauce. It can be made with slices of bread and butter.

**Apple Float.**

Take six good sour apples, stewed and made into sauce; let them cool, and add a teacupful

of sugar, and flavor with vanilla and the beaten whites of three or four eggs. Serve at once.

**Charlotte Russe.**

Make a sponge cake; cut it into pieces to fit the bottom and sides of a Charlotte mould; whip a pint of rich cream to a stiff froth and fill the mould and let it stand on the ice to set. It is improved by the beaten whites of three eggs stirred into the cream. Flavor with vanilla or to suit the taste.

**ANOTHER RECIPE.**

Make a pint of custard—two eggs to the

pint of milk; then dissolve a box of gelatine in a pint of water and let it boil as in making jelly; strain each into the same vessel—a tin pan is best—and stir it gently all the while, until it gets cold. In the meantime, take a quart of cream, season with vanilla, sweeten with a pound of sugar, and churn it to a froth; skim the froth and stir it into the mixture as soon as it begins to thicken. (*Jennie June.*)

**Strawberry Cream.**

Take two quarts of strawberries mashed fine; soak half a box of gelatine for an hour in half a cup of warm water and add the juice

of the strawberries, straining often, with a cup of sugar and a pint of whipped cream. Pour into moulds.



**Fruit Creams.**

Take half a pint of peach or pine apple marmalade, stirred smooth with a teaspoonful of sweet cream; add half a box of gelatine dissolved in a cup of boiling water, and when cold add one pint of whipped cream. This is delicious and not expensive.

**Apple Soufflé.**

Take half a dozen greening apples, or any tart apples; pare, core and slice them; stew them gently to a pulp, sweeten them and flavor to taste; put them into a deep dish, and when thoroughly cold pour over them a rich custard made in the ordinary way; whisk the whites of five eggs to a stiff froth and drop it in spoonfuls upon the top of the custard, and sifting white sugar over the tops of them; set in the oven until the egg is brown; serve cold.

**Orange Pudding.**

Beat up the yolks of eight eggs; grate the rind from two oranges; add a quarter of a pound of pulverized sugar, a quarter of a pound of fresh butter, three teaspoonfuls of orange-flower water, two glasses sherry wine, three lady fingers, and a little cream; line a dish with puff paste, pour in the mixture, and bake for half an hour in a quick oven.

**Apple Marmalade.**

Pare twenty pounds of pippin apples, make a syrup of ten pounds of sugar; boil the apples sufficiently in it to mash them; then take them out, beat them fine, and put them back; cut six oranges into small pieces and boil together, stirring it till done. (*Jennie June.*)

**BEVERAGES.****Chocolate.**

Use two ounces or squares of cocoa paste to each pint of milk; put the milk into a saucepan and when raised to the boiling-point, throw in the cocoa, which has been scraped or grated fine; boil five or six minutes, stirring all the while; do not let it boil over; sweeten to taste with white sugar. It may be flavored with vanilla or powdered cinnamon for a change. Serve very hot. Water may be used instead of milk; then serve with cream.

**Laced Chocolate.**

Scrape two ounces of cocoa paste, put it into a saucepan with a small quantity of water, cook slowly and stir to a smooth paste; then add four ounces of pulverized sugar and one pint of good claret. Serve with biscuit or with plain cake.

**Coffee.**

To make coffee according to the French plan procure a pot and biggin; put the ground coffee into the biggin, press it down tightly with the stamper attached, and pour *boiling* water over it until it bubbles up through the upper strainer; then put on the lid until the water has filtered through the coffee; fill up again with more boiling water until you have the desired quantity. This plan retains the aroma and flavor to a great extent. Allow a quarter of a pound of coffee to one quart of water.

Following is an excellent way to make coffee:

**ANOTHER RECIPE.**

Grind the coffee and put it into a tin coffee pot allowing one tablespoonful to each person; then add a little of the white of an egg and roll the ground coffee around in the pot until mixed through it; then put about one tablespoonful of *cold* water on it; have the kettle on the fire and the *minute* it *boils* pour the boiling water on it and place it on the fire to boil from fifteen to twenty minutes. *Coffee should not boil long*, and be served at once.

**Café Noir or Black Coffee.**

Is simply the very strongest preparation of coffee that can be made, and is usually used sweetened and without cream. Some persons add a very little cognac to it. (*Caterer.*)

**Tea.**

A tin tea pot should never be used; earthenware is preferable to tin. Allow an even teaspoonful of dry tea for each person; scald the tea pot with boiling water, and pour it off; put

in the tea and on it a little *boiling water*, letting it stand. When ready for the table fill to the required amount with boiling water, a cupful to each person. English breakfast tea *never* boil.

## SPECIAL DIETETICS.

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DR. PAVY's incomparable work on "Food and Dietetics" forms the basis of these remarks on special dietetics.

### To Reduce Corpulency.

*Liquid Food.*—Acid wines should be preferred to sweet wines, and cider to malt liquors. Water should be plain or mixed with small proportions of vinegar, which is better than lemon juice, as, in vinegar, fermentation is finished. Tea and coffee should be taken *without cream*.

*Solid Food.*—The bread should have bran in it. Vegetable diet is to be preferred to other diets. If animal food is used, let it be fish, or lean and dry meat. Eat no eggs or butter, and the less sugar the better.

Mr. Banting's great success in reducing himself from corpulency to comely dimensions by dietetic measures, was brought about by substituting the following dietary for his original one :

*Breakfast at nine A.M.*—Five to six ounce of either beef, mutton, kidneys, broiled fish, bacon, or any kind of cold meats, except pork or veal. A cup of tea or coffee (no milk or sugar), a little biscuit or an ounce of dry toast, making six ounces of solids and nine of liquids.

*Dinner at two P.M.*—Five or six ounces of any fish, except salmon, herrings, or eels ; any meat, except pork and veal : any vegetable except the potato, parsnip, beet, turnip, or carrot : one ounce of dry toast ; fruit out of a pudding not sweetened ; any kind of poultry or game : and two or three glasses of good claret. Sherry or Madeira, champagne, port, and beer, are forbidden. Thus are used ten to twelve ounces of solids, and ten of liquids.

*Tea at six P.M.*—Two or three ounces of cooked fruit, a rusk or two, and a cup of tea, no sugar or milk ; making two to four ounces of solids, and nine of liquids.

*Supper at nine P.M.*—Three or four ounces of meat or fish similar to that at dinner, with a glass or two of claret, or sherry and water ; making four ounces of solids, and seven of liquids.

It must not be lost sight of that the *quantity* of food in Mr. Banting's dietary is such as would be calculated to contribute its share of influence toward reducing the weight of the body ; and it certainly must not be

looked upon as safe to be indiscriminately followed ; many persons have incurred a serious impairment of health by keeping too strictly to the letter of the recommendation given. The dietary provides twenty-two to twenty-six ounces of solid food, with thirty-five ounces of liquids, per diem.

As a résumé for the guidance of the corpulent, the fat of meat, butter, cream, sugar and sweets, pastry, puddings; farinaceous articles, as rice, sago, tapioca, etc. ; potatoes, carrots, parsnips, beets, sweet ales, porter, stout, port wine, and all sweet wines should be avoided, or used but sparingly. The articles allowed are lean meat, poultry, game, eggs, skimmed milk moderately, green vegetables, turnips, succulent fruits, light wines, as clarets, port, etc., dry sherry, bitter ale in moderation, and spirits. Brown bread is better than wheaten bread. Gluten biscuits being comparatively free from starch may be used as a substitute for bread. To abstain from drinking water is a great factor in this course of dietetic treatment for obesity. A good plan is to gargle with cold water when the thirst is great. Water and all watery substances have great power to produce fatness. Dio Lewis' advice to an over-fat lady is this : " If you are fond of meat, all the better ; increase the proportion a little. Masticate the food very thoroughly, so that you will need very little drink to swallow it. When you have a desire for drink, content yourself with a single mouthful. In a week or two you will be surprised to find how the wish for water has disappeared. If you can learn to get on with one tumblerful of water or other drink each day, this fat, shaky condition will at once begin to disappear. But to speak of your food again : Reduce the quantity you now eat one-quarter, and after, say, two months, reduce another quarter. This reduction will probably be sufficient, if you rigidly observe what I said about drinks. If, in addition to this, you exercise yourself into a profuse perspiration once or twice a day, you will be astonished how soon your clothes will become loose."

Some physicians are of the opinion that the Banting system of living on meat is entirely unnecessary ; that it is much better to keep up about the usual proportions of meat and vegetable food, and simply to reduce the quantity. No one need fear becoming weak and faint from such a course. On the contrary, it will give a sense of lightness and increasing strength. The breathing will be better, and the movements quicker. A person who weighs two hundred and fifty pounds, to become active and in prime health, should reduce his weight to one hundred and fifty or seventy-five pounds. Such a one carries about an extra weight of seventy-five pounds, interfering with his respiration and activity. It is a noticeable fact, that all fat people are large drinkers. Now, remembering that about three-fourths of the human body is water, it is easy to see what an intimate relation with a fat condition the large use of drinks may have. Then, again, a fat person must not indulge



in sleep as a luxury. Long sleep fattens. Seven hours of sleep, or better six hours, in the twenty-four, will do. "Keep your eyes open and your mouth shut," is the prescription for obesity.

### To Gain Flesh.

It is well known that the conditions most conducive to the accumulation of fat is a diet rich in either fat or the requisite amount of nitrogenous matter, exposure to a warm atmosphere, and inactive habits. The dietary to be prescribed should comprise such articles as fat meats, plenty of butter, cream and milk, cocoa, chocolate, bread, potatoes, peas, parsnips, carrots, beets, farinaceous and flour puddings, pastry, almond puddings and biscuits, custards, oatmeal, sugar and sweets, sweet wines, porter, sweet ale, and liquors. Instead of going to bed at eleven or half-past eleven, if you are really in earnest about getting a plump, youthful appearance, you must go to bed at half-past eight or nine o'clock, and do not be in a hurry about getting up in the morning. On going to bed, and on getting up in the morning, drink as much cold water as possible. Soon you will learn to drink two tumblerfuls, and some persons will learn to drink more. Drink all that the stomach will bear. Spend a good deal of time in the open air without hard exercise, but exposed to the sun. If practicable, ride in a carriage some hours every day. Remain out enough to give you a good appetite, but do not work hard enough to produce excessive perspiration. Eat a great deal of oatmeal porridge, cracked wheat, graham mush, baked sweet apples, roasted and broiled beef, though the vegetable part is more fattening than the animal part. Lie down an hour in the middle of the day, just before you take your dinner, to rest, and if possible take a little nap. Associate with jolly people; the maxim, "Laugh and grow fat," rests upon a sound physical basis. A pleasant flow of social spirits is a great promoter of digestion. Keep your skin clean. Sleep in a room where the sun shines. Keep everything sweet and clean and fresh about your bed. Sleep nine or ten hours, and in six months you will be plump and fresh. The prescription in short is, "Keep your eyes shut and your mouth open."

### Diet for Gout.

Gout arises from the consumption of a highly nitrogenized diet. What is drunk is more important than what is eaten. It is not the distilled spirits, but the stronger wines and malt liquors which favor production of gout. Nothing is a more potent cause than port wine. Therefore, in the dietary, only dry sherry and light wines, as claret, burgundy, hock, champagne, etc., may be drunk, and these in moderation. Pure whisky, or brandy, diluted with water, often forms the only kind of alcoholic drink that is found to agree with those suffering from gout. The diet should be simple, and the higher the degree of inactivity the greater ought to be the

preponderance of food derived from the vegetable kingdom. Gout seldom attacks persons employed in constant bodily labor, or those living upon vegetable diet. The temptation of eating too much should be firmly resisted.

### Diet for Diabetes.

Diabetes is a morbid condition, attended with a lack of assimilative power over the starchy and saccharine principles of food, and to avoid these symptoms the dietary requires, as far as practicable, an exclusion of these principles.

Persons liable to diabetes may use, in their diet, butcher's meat of all kinds, except liver; ham, bacon, or other smoked, salted, dried, or cured meats; poultry, game; shell-fish and fish of all kinds, fresh, salted, or cured; animal soups not thickened, beef tea, and broths; the almond, bran, or gluten substitute for ordinary bread; eggs dressed in any way; cheese, cream cheese, butter, cream; greens, spinach, turnip tops, \*turnips, \*French beans, \*Brussels sprouts, \*cauliflower, \*broccoli, \*cabbage, \*asparagus, \*sea kale, \*vegetable marrow, mushroom, water-cress, mustard and cress, cucumber, lettuce, endive, radishes, celery; vinegar, oil, pickles; jelly, flavored, but not sweetened; savory jelly; blanc-mange made with cream and not milk; custard made without sugar; nuts of any description, except chestnuts; olives; tea, coffee, cocoa from nibs; hock, dry sherry, claret, dry sauterne, burgundy, chablis, brandy, and spirits that have not been sweetened; soda water; bitter ale in moderate quantity.

The diabetic should abstain from using sugar in any form; wheaten bread and ordinary biscuits of all kinds; rice, arrowroot, sago, tapioca, macaroni, vermicelli; potatoes, carrots, parsnips, beet-root, peas, Spanish onions; pastry and puddings of all kinds; fruit of all kinds, fresh and preserved; milk, except sparingly; sweet ales, mild and old; porter and stout; cider; all sweet wines, sparkling wines, port wine, unless sparingly; liquors.

### Diet for Dyspepsia.

The food for a dyspeptic must be simple and plainly cooked. It is better to raise the digestive capacity to the power of digesting light and ordinary food than to reduce the food to a lower grade. Mutton in almost all cases is most suitable, and will often be retained when other meats lie too heavily. Chicken and game are allowed; also fish, which must be *boiled* or *broiled*. Codfish is an exception. Stale bread and dry toast, floury potatoes, rice, and the various farinaceous articles form the food that can be eaten from the vegetable kingdom. It will be important for

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\* Those articles marked with an asterisk may only be eaten in moderate quantities, and should be boiled in a large amount of water.

the patient to be guided by what is found from experience will agree with him, and avoiding that which is known to be of an indigestible nature. The diet should be kept as close to what is natural as circumstances will permit, and it is not necessary to reduce it to almost exclusively liquid food. The power of the stomach, already weak, becomes weaker for the want of proper employment.

### Full and Low Diets.

The terms "full diet" and "low diet" are often used by physicians in their directions to nurses. Pavy gives the full or extra, the middle or ordinary, and the low diet of Guy's Hospital as follows:

*Full or Extra Diet.*—Fourteen ounces of bread; one pint of porter for males, half a pint of porter for females; six ounces of dressed meat, roasted and boiled, alternately, with eight ounces of potatoes; half a pound of rice pudding three times a week; half a pint of mutton broth in addition on days when boiled meat is given (which is four times a week); or, occasionally, one pint of strong vegetable soup, with meat and rice pudding, twice a week; one ounce of butter each day; porridge, gruel, and barley water as required.

*Middle or Ordinary Diet.*—Twelve ounces of bread; half a pint of porter; four ounces of dressed meat roasted and boiled, alternately, with eight ounces of potatoes; half a pound of rice pudding three times a week; half a pint of mutton broth in addition on days when boiled meat is given (which is four times a week); or, occasionally, one pint of strong vegetable soup, with meat and rice pudding, twice a week; with the full diet allowance of bread; one ounce of butter each day; porridge, gruel, and barley water as required.

*Low Diet.*—Ten ounces of bread; half a pint of beef tea, mutton broth, rice, arrowroot, or sago, when specially ordered; three-quarters of an ounce of butter; gruel and barley water as required. Wines and spirits, if used, must be mentioned each time the physician or surgeon attends.



## THE GENERAL CARE OF CHILDREN.

THE proper management of children is the most important subject that can be brought to the consideration of a parent ; and, yet, it is one that has been greatly neglected. Mothers undertake the management of children without previous instruction, thinking it can be learned by instinct, or by affection. The consequence is they find themselves too often in a condition of uncertainty and trouble, and act not unfrequently directly in opposition to the best physical and mental welfare of their charges. Undoubtedly the proper management of a child begins even before birth ! Prenatal influences and education are of vast importance ; yet how greatly neglected, and persistently misunderstood ! Those who would have healthy children, must be themselves healthy. They must obey the laws of nature and morality. They must not expect good fruit from poor soil. Physical strength, good organization, agreeable temper, and nobleness of mind beget their like ; drunkenness, debility, debasement of body and mind yield similar characteristics in the progeny. Children who inherit the former start from the highest vantage ground ; children with the latter start in the race of life handicapped and at a great disadvantage. From the earliest moment after conception, the mother should pay even more than usual care to her personal health. Her clothing should be loose and comfortable, and adapted to the gradual development of her abdomen and breasts. Tight lacing is injurious to both child and mother, and should be carefully avoided. The judicious use of tepid baths once or twice a week, with a daily sponge bath of luke-warm water, followed by friction with a coarse towel, will be conducive to her welfare. The mother should also take short, gentle, and frequent walks during the whole period of pregnancy. In fact she should spend much of the time in the open air, with mild exercise and occupation, and in this way her general health will be kept in proper tone, the bowels open, and the growing fetus will be nourished and strengthened, and the foundation laid for an easier labor and a good getting up. This abundance of air and occupation explains the rapid labors and speedy recoveries of poor women. Such need to work, but in their very toil they are favoring nature's operations, and their compensation is in an easy confinement, unattended with much inconvenience or anxiety. In-

dolence during pregnancy is enervating to mother and fetus. A pregnant woman is not an invalid. She is not compelled to lie down most of the time. To be with child is a natural physiological process, the fulfilling of the Divine mandate, and the highest crowning act of womanhood.

The pregnant woman should exercise some care of her dietary. Meat should be eaten but once a day; rich soups and highly-seasoned foods avoided, and all alcoholic and other stimulants strictly shunned. She should eat rather less during early pregnancy than at ordinary times; for while it is true she has two to provide for, yet she has less drain upon her system, from the fact that she no longer is unwell, and the fetus, up to the third month, is not much larger than an egg. An overloaded stomach also may favor the distressing nausea and morning sickness of early pregnancy. During the latter months of pregnancy the diet should be fuller, for if it is too light it is likely to make the mother a poor nurse for her child, both in the quantity and quality of her milk.

A pregnant woman should retire early to rest—at least by ten o'clock—and be up in good time in the morning for her ablution, morning stroll in seasonable weather, and an early breakfast. In short, she should use every means in her power to make and keep herself healthy, not only for the sake of herself and her husband, but also for the sake of her forming child and for the welfare of the human race. It should be borne in mind that the period of intra-uterine life is one full of danger to the health of the fetus; not only does ill health in the mother react upon the defenceless little creature, but it may be, her thoughts, her mental and moral states, her passions, are reproduced in the child. It is of the utmost importance then that she be surrounded with comfort, cheer, and happiness; that no unkindness be shown her by her husband or family; that she have all advantages of mental ease and comfort to implant in the miniature human being qualities good and noble. How readily mothers believe in birth-marks, and yet how ignorant or negligent are they of prenatal impressions affecting health and morals.

It is to be remembered that during a prolonged period mother and child form together but one living system, and whatever injures the mother's constitution also involves that of her progeny.

It must be borne in mind that the health of the father, at the time of the impregnation, also influences very much the future child's welfare.

#### Care of the New-Born Infant.

While no one is herein advised to usurp the place of a physician or a skilled nurse in the lying-in room, yet, under peculiar circumstances, it may fall to the lot of some member of the family to act in an emergency as a nurse, or even as a physician. In such a case, just as soon after birth as the breathing process is well established in the babe, tie the navel cord about one and half inches from the infant's stomach with a stout white

string. Do not use cotton thread, even if doubled. It is well to tie the cord again one inch beyond the first tie, and cut with a sharp pair of scissors between these two ties, using care not to let a sudden movement of the child plunge the scissors into its flesh. Roll the child in a suitable covering and lay it aside until the care of the mother, as described on page 591, is over.

When the mother has been made comfortable, attention should again be directed to the child, and, first, it should have a bath. It is not uncommon to hear cold water advised for the first bath of a new-born infant, under the impression of its strengthening the child. This is not sound advice. If water is used warm (not hot) it will not enervate, nor be likely to cause colds and inflammations, which attend the use of cold water. After rubbing well with good grease, as olive oil, cold cream, or cosmoline, the parts of the body containing the peculiar white paste-like substance found upon the new-born infant, wash well with a piece of flannel, warm water, and castile soap, finishing with a large sponge, by which the water can be made to stream over the child, acting like a miniature shower bath. Under ordinary circumstances there is no need of adding brandy or liquor of any kind to the water. After the bath dry the skin well with soft towels, rather absorbing the moisture than using any severe rubbing; then dust all the parts likely to chafe with some simple dusting powder, starch, lycopodium, or violet powder. While bathing the child the nurse should wear a thick, soft flannel apron, made long and full.

If the infant should breathe feebly, or exhibit other signs of great feebleness, it should not be washed at once, but allowed to remain quiet, warm, and undisturbed until the vital actions have assumed a fair degree of activity.

*The Care of the Navel.*—There is nothing better for dressing the navel than a piece of soft rag *unsinged*, which should be greased and neatly wrapped around the cord, as you would wrap a cut finger, kept in place with a few rounds of thread. The navel string thus covered should lay upward on the belly, and be supported in this position by means of a bandage passed around the child's body—a simple strip of flannel, about four inches wide, being the most suitable bandage. Care should be used not to draw this bandage too tight around the abdomen. It should be loose enough to admit the introduction of a finger between it and the belly. The proper use of the bandage prevents rupture at the navel, while if applied too firmly it compresses the abdominal cavity, so that in the forcible descent of the diaphragm in the act of crying, coughing, and straining, it presses the internal organs downward and forces the bowels through the natural openings in the walls of the abdomen, thus producing rupture in the groin. The bandage should be worn for four to six months before it is laid aside.



The navel string usually separates in a week's time, but it may be delayed for twice this length of time. This will make no material difference, and the rule is to allow it to drop off of its own accord. If the navel is a little sore after the separation of the cord, or if excoriation occurs before it is fully separated, cleanliness in connection with a bland, soothing salve will be all that is required.

### Clothing for the Infant.

To be more explicit about the bandage, which has been already mentioned, before, it may be added that it is usually cut the selvage way of the material, as are cuffs and wristbands. Some persons prefer the horizontal strip as being more elastic, while we have known a prominent physician who forbade the use of any but bias bands, especially for boy babies. The band should be cut in one piece, and never hemmed, since any seam might hurt the tender body it is to girdle. Sometimes the band is bound with silk flannel binding and sometimes buttonhole-stitched on the edges with coarsely twisted silk floss, but generally the edges are left raw. Knitted bands are excellent. For these cast on one hundred and thirty stitches, and knit with four needles in Saxon yarn or zephyr worsted, in the well-known rib-stitch, knit three and turn two. Knit the band from six to seven inches deep. This band is elastic enough to yield to every breath of the infant and yet sufficiently strong to afford support to the tender back. Except in midsummer, a knitted shirt of Saxon yarn should also be worn, and even then, when the band is removed, the shirt should take its place.

The narrow coat or pinning blanket for wear at night, and during the day also, for the first month of the infant's life, is a straight piece of flannel, three-quarters of a yard in length and a yard and a half wide, gathered into a straight band of muslin four inches broad and twenty inches long. The belt must be pinned, as it will be too large for a young infant; below it the skirt, which is to be left open like an apron its whole length, must be furnished with buttons and buttonholes close enough together to prevent the child from getting its feet through. Flannel, with one part of cotton to three of wool, corded together, is better than all-wool for this, as it shrinks less.

The rubber diaper has many friends and many foes, and there is much to be said on both sides. If the nurse is careful it will be found a comfort, since it keeps the clothing dry, and can do no harm except where it is made an excuse for not changing the child as frequently as is necessary. When it is used there should be two or three, and they should be frequently aired. Wash them always in cold water, and wipe on a towel; then hang them in a cool place to dry. When the baby's skin is very delicate their use may cause chafing, unless great care is taken; this is the only valid objection urged against them.

*The Quality and Quantity of Clothes.*—The quality and quantity of the child's clothing must be regulated by the means of its parents. Every mother will probably have the best she can afford, but, whether rich or plain, it should be carefully made: all seams felled, and no rough edges left to chafe the tender skin. Much trimming is unnecessary, and she who can afford to spend only a limited amount on her baby's wardrobe had best put most of that into the material of which they are made. Coarse flannels, heavily embroidered; cheap cambric loaded with tawdry cotton laces or coarse Hamburg edges, are not to be compared to finer materials simply made: the flannels overcast with zephyr wool or linen floss; the cambric or nainsook slips finished with a plain hem, or a ruffle of the same, and with a tiny edge at the neck and sleeves. Six of every garment—three night flannels and three for day—constitute the minimum layette. Twelve diapers may answer, by careful management, but unless they can be washed every day at least eighteen will be required. A flannel cape or a woolen shawl is necessary to throw around the child in passing from one room to another during the first weeks of its existence. Summer and winter, until it is two years old, it should wear a flannel shirt long enough to cover the bowels. The knitted shirt already described is sufficient for the first six months and for warm weather. In the winter it should be replaced by high-necked and long-sleeved flannels. Some children require bibs by the dozen, others scarcely need them at all. Fleece-lined pique and nainsook wadded and quilted are the best materials to make them of. Infants' cloaks are usually of white merino trimmed with white silk, satin, fringe, swan's down or embroidery, as the parents may fancy or can afford. In shape they should be a long circular or a sacque, each having a long cape. The first head covering is a lace or shirred muslin cap, lined in winter with white merino or fine flannel for warmth.

A nightgown of muslin or white percale—cambric is too thin and linen too cool, except for summer—and a flannel wrapper, to be worn on cold nights, with its napkin, complete the child's night dress. Cotton diaper is best for use in winter, linen in summer, and some mothers prefer canton flannel for night wear in winter. The same material—canton flannel—should always be used for children's night gowns in cold weather after the child is six months of age. The day petticoats should be two breadths wide, the flannel cut straight, the muslin one slightly gored. Many mothers do not put their babies into long clothes at all: making the skirts eighteen inches long at first, a length which comes down well over the feet, but little more, and letting the infant wear woolen socks to keep its feet warm—a sensible fashion which it is to be hoped may some day be generally adopted. The superstition that it is unlucky to put an infant's long clothes on over its head is a fortunate one for the babies, since it is a worrying process to have so much pass over the little face,

not to speak of the danger to the tender spine, since it is a difficult matter to give it proper support while holding the baby up for the operation. On the other hand, in putting them on feet foremost the infant lies comfortably on the lap, while its feet and legs are lifted and drawn as far into the skirts as is necessary.

Before beginning to dress the baby have everything ready, so that the operation may be quickly and comfortably performed.

The clothing of an infant should be warm, light and loose. Its clothing generally is too long and cumbersome. All that is required is for the feet to be well covered. The parts of the child's body that should be kept warm are the chest, bowels, and the feet. None of the clothing should be tight enough to make undue pressure upon the blood vessels, impeding the circulation and hindering the proper development of the body. The lungs and heart must not be kept from having free play, and pressure over the stomach impedes digestion.

Pins should be used sparingly about the clothing. Even the diapers could be fastened with loops and tapes. When pins are used they should always be of the safety kind.

During the early months of the child's life, warmth is peculiarly needful for the infantile system, and where there is any tendency to weakness and imperfect development of animal temperature, flannel clothing is particularly necessary to favor the accumulation of warmth in the infant's body. Benefit may also result from its gentle stimulating action upon the cutaneous surface. In hot weather muslin may be used instead of flannel, but even then a careful mother or nurse will change at once the clothing to suit the varying states of the weather. In summer infants are not infrequently kept too warm by too thick and warm coverlids while sleeping.

With its usual clothing the infant is often laid upon a bed of feathers, and covered with a thick spread. This causes a copious perspiration, making the baby liable to catarrhal and bowel complaints, if exposed immediately afterward to a current of fresh and cool air. It is important for the welfare of the child that it should not be permitted to sleep in the same flannel or underclothing as worn during the day. The baby's head should be kept cool. Caps for this reason are objectionable. If caps are used it is needful to use care in leaving them off, to guard against cold. When they are to be discontinued, use a thinner and a thinner one until they are left off altogether.

When the child is sent out for an airing, which may be done in two weeks after birth in summer, and in a month's time in winter if the weather is good, and in midday; be sure that it is well wrapped. A knitted worsted spencer, buttoned behind, for wear under the cloak, and a shawl over all if the weather is cool, will protect the little one from harm.

The proper time for "shortening" the clothes is about the end of three



months in summer, or six months in winter. This shortening should be only of the extra length, being still long enough to extend below the feet for nearly a year, to protect the lower parts of the body against changes in temperature. By the end of a year the feet should be entirely free, so as to allow free motion of the legs.

While the dress is long, in cold weather, fine woolen stockings, wide enough to be easily put on and to avoid every degree of compression, should be worn; in summer light and soft flannel socks will answer. As soon as shortening is made, shoes are proper. The shoes should be made of light and pliable materials, and large enough to prevent all constraint of the feet. Some authors object to putting shoes on infants, claiming they cramp the feet, restrain their free movements, and retard the child's learning to walk; but if the shoes be large enough and made of good, pliable material, these objections will be obviated. Dr. Dewees says: "Shoes afford protection from cold, and security against accident when the child is placed upon the floor, especially on carpeted floors, where pins, needles, and other sharp substances, are often concealed.

The child should be kept dry as possible. Wet diapers or stockings, when permitted to remain on the child for some time, give rise to bowel and febrile complaints. They tend to cover excoriations and painful irritation of the skin about the groin and buttocks. Examine frequently the underclothing of a child, and if any part be found wet, immediately replace it by a dry and clean one.

### Infant Bathing.

Every one will agree that an infant should be regularly bathed from head to foot once a day. The water should be tepid—not hot—and barely warm. After the child is three weeks old it may be put into the water and supported with one hand, while it is washed with the other. It is surprising how soon it will learn to enjoy its bath, to splash and play in the water. Never allow it to remain too long in its tub—from ten to twenty minutes is the limit, the latter time being for a healthy child in warm weather. Wet its head before putting it into the bath. This is to guard against congestion. Use white castile soap, and either a very soft sponge or an equally soft flannel or linen cloth. Wipe quickly, and dry with a soft towel, holding the child meanwhile upon a blanket in your lap. See that every little crease is wiped out and powdered with corn-starch. Burnt flour should be used in case of chafing. Be careful to guard against draughts, and bathe the child near an open fire, if possible—if not, the bath should be given in a perfectly warm room. Have the clothing hanging at the fire, well warmed and ready to put on at once. The petticoats should be put one in the other, and the dress over them, so that all three may be slipped on at once. Every little waist should be

furnished with buttons or buttonholes and with drawing-strings at top and bottom for drawing to the proper size.

An infant's mouth should be cleansed several times a day with a soft fine rag dipped in clear water. This is especially important in summer and during dentition.

#### Amount of Sleep Required Each Day by Children.

|                       |     |                             |
|-----------------------|-----|-----------------------------|
| At 4 months . . . . . | 20  | hours of sleep is required. |
| At 6 months . . . . . | 18  | hours of sleep is required. |
| At 1 year . . . . .   | 15  | hours of sleep is required. |
| At 2 years . . . . .  | 13  | hours of sleep is required. |
| At 4 years . . . . .  | 12  | hours of sleep is required. |
| At 7 years . . . . .  | 11  | hours of sleep is required. |
| At 9 years . . . . .  | 10½ | hours of sleep is required. |
| At 14 years . . . . . | 10  | hours of sleep is required. |

#### Infant Feeding.

Whenever possible, breast milk should be the infant's food. Young infants should be able to obtain about a quart of milk a day from this source; at three months the demand is for three pints; at six months for nearly two quarts. Early in its life the babe should be fed once in two hours, and gradually the interval should be extended until the child is nursed about six times in the twenty-four hours. If the mother finds her milk supply scanty or too rapidly failing, she must use such means as tend to promote the secretion of milk. All powerful emotions and excitements must be avoided. Gentle friction, electricity, moderate coition, and a proper diet favor the lacteal flow. The diet should be generous, avoiding rich and made dishes, using plenty of milk, eggs, meats, fowls, game, fish, and a very moderate amount of some malt liquor. Oysters, whiting soup, conger-eel soup, and crabs, are reputed milk promoters. Pea soup, lentil soup and turnips, fennel and parsnips, are also recommended. Cocoa, chocolate, and cod-liver oil are useful adjuncts to the diet of a nursing woman. A number of medicines are now used for the purpose of stimulating this function of milk secretion, but their application belongs to the domain of therapeutics, and should be used only by the direction of a physician. The best test of the quality of the mother's milk is whether the child thrives or does not thrive. As a rule, no artificial food whatever should be permitted when the breast milk is good; at any rate, not until the sixth or seventh month.

#### Comparative Value of Breast Milk and Artificial Feeding.

Without a doubt, breast milk is of incomparably greater value than any artificial food, both as regards the chance of life and the proper development of the child. It is impossible to lay too much emphatic stress on this point, and those mothers who, from reasons of indolence,

fashion, and what not, refuse to perform the sacred duty of nursing their children, must, in most instances, be considered responsible for the weakness, disease, and even death, which their willful neglect may entail. The mother who does not nurse her infant, does not make as good a "getting up." "A mother who does not suckle is more liable to peritonitis, inflammation of the uterus, abscess in the breast, and cancer of the breast and womb." Women, after confinement, often suffer from back-ache, aching in the thighs, inability to stand long, or to walk much. They have bearing-down pains, feelings of heaviness; they tire easily, and feel themselves to be quite invalids. The cause is often an over-large uterus; one that has never properly contracted after confinement. This condition, if neglected, leads to falling of the womb, inflammation and ulceration of this organ, whites, and the various disorders usually called uterine complaints. Now, it is certain that suckling has a very beneficial influence in causing tonic contraction of the womb, and thus preventing the unpleasant and painful train of symptoms just mentioned.

### Artificial Feeding.

There are times when a mother cannot and should not nurse her child a wetnurse should then be the first thought. A child that has been nursed for a short period, either by the mother or by a wetnurse, can be very much more easily brought up by hand than one that is obliged to be hand-fed from birth. When artificial feeding is the only course left to pursue, then the great question is upon what food to place the child. This depends upon the age, state of health, residence in country or city, and upon the circumstances of the family. Milk should form the basis of all preparations of food. For infants it should resemble as nearly as possible the mother's milk. The difference in the milk of various animals is shown by the following table:

Difference in Milk of Various Animals. (Payne.)

|                                          | <i>Women.</i> | <i>Cow.</i> | <i>Goat.</i> | <i>Sheep.</i> | <i>Ass.</i> | <i>Mare.</i> |
|------------------------------------------|---------------|-------------|--------------|---------------|-------------|--------------|
| Nitrogenous Matter and Insoluble Salts . | 3.55          | 4.55        | 4.50         | 8.00          | 1.70        | 1.62         |
| Butter . . . . .                         | 3.34          | 3.70        | 4.10         | 6.50          | 1.40        | 0.20         |
| Lactin and Soluble Salts . . . . .       | 3.77          | 5.35        | 5.80         | 4.50          | 6.40        | 8.75         |
| Water . . . . .                          | 89.54         | 86.40       | 85.60        | 82.00         | 90.50       | 89.33        |
|                                          | 100.00        | 100.00      | 100.00       | 100.00        | 100.00      | 100.00       |

It will be seen by this table that the milk of the cow most closely approximates to that of woman, but it is rather more highly charged with each kind of solid constituent.



### Various Dilutions of Milk for Various Ages.

Mother's milk for new-born babes is so peculiar as to have obtained a special name, *colostrum*. It gradually loses those peculiarities. Colostrum, or milk prepared for the first two weeks of a child's life, must contain much butter. From two quarts of milk, which has stood four or five hours, skim off carefully half a pint, or the last tenth of milk just stripped from a cow. For example, if a cow gives five quarts, the last pint may be used. This milk must be largely diluted with water, according to the following schedule. Milk is to be made more nutritious as the child advances in age, regard being had, not to mere age, however, but to the condition of the child—the schedule, being arranged to suit vigorous children, will not suit feeble ones, who must be kept back on the scale.

If the milk be too strong, indigestion will follow, and the child will lose instead of gaining strength. When particles of casein, or curd, pass through its bowels unaltered, a milder quality or lower grade should be substituted. A feeble child of six months may require the food suited to a vigorous child of six months. For constipation, increase the richness of the milk—put in more cream. In cold weather, or if milk is kept on ice, it may stand an hour or two longer before the upper third is removed; or the upper fourth may be taken, or set five quarts instead of three to get one quart.

The water used in diluting milk should not be hard; nor should it be boiled. Add it to the milk, and heat it by putting the bottle in warm water.

Schedule for the Dilution of Cow's Milk.

| AGE OF CHILD.             | MILK.   | WATER. | WHOLE QUAN'TY. |
|---------------------------|---------|--------|----------------|
|                           | Gills.† | Gills. | Gills.         |
| 2 to 10 days . . . . .    | 1½      | 3½     | 4½             |
| 10 to 20 days . . . . .   | 1¾      | 4½     | 6              |
| 20 to 30 days . . . . .   | 2½      | 6      | 8½             |
| 1 to 1½ months . . . . .  | 3       | 6¾     | 9¾             |
| 1 to 2 months . . . . .   | 3½      | 7      | 10½            |
| 2 to 2½ months . . . . .  | 4       | 7½     | 11½            |
| 2½ to 3 months . . . . .  | 4½      | do.    | 12             |
| 3 to 3½ months . . . . .  | 5       | do.    | 12½            |
| 3½ to 4 months . . . . .  | 5½      | do.    | 13             |
| 4 to 4½ months . . . . .  | 6       | do.    | 13½            |
| 4½ to 5 months . . . . .  | 6½      | do.    | 14             |
| 5 to 6 months . . . . .   | 7       | 7      | 14             |
| 6 to 7 months . . . . .   | 7       | 7      | 14             |
| 7 to 8 months . . . . .   | 8       | 6      | 14             |
| 8 to 9 months . . . . .   | 8½      | 6      | 14½            |
| 9 to 10 months . . . . .  | 8½      | 6      | 14½            |
| 10 to 11 months . . . . . | 8½      | 6½     | 14½            |
| 11 to 12 months . . . . . | 9       | 5½     | 14½            |
| 12 to 15 months . . . . . | 9½      | 5½     | 14½            |
| 15 to 18 months . . . . . | 9½      | 5      | 14½            |
| 18 months . . . . .       | 10      | 5      | 15             |

† Eight large spoonfuls are about a gill.

*Sweetening.*—Use loaf sugar enough to make it as sweet as undiluted new milk, a teaspoonful to a quart. If too sweet, it will cloy the appetite, and not enough food will be taken.

*Temperature.*—The milk should be heated to 100° Fahrenheit; test it once, and try it on the cheek, which should regulate it subsequently.

Although it has been so strenuously urged that the milk for an infant's diet should all come from one cow, the fact is this, it does not make so good a diet for children as the milk from several cows.

Dr. Meig's formula for artificial feeding with milk is as follows: Order five or six packages of milk sugar, containing seventeen and three-quarter drachms each; the contents of one of these to be dissolved in a pint of water, and each time the child is to be fed let there be mixed together, and then warmed, three tablespoonfuls of the sugar solution, two of lime water, two of cream, and one of milk. This makes about a gill, and as much of it as the child does not take should be thrown out and a fresh mixture made for the next feeding. The solution of sugar should be kept in a cool place and at once thrown away if it sours, as occurs if kept more than a day or two in warm weather. The dry sugar keeps indefinitely, and is easily dissolved in warm water. A pint bottle should be kept for the purpose of containing the solution, to serve also as a measure of the quantity of water to be used with each package dissolved, and also to save further measuring. The milk to be used should be good ordinary cow's milk, and not the very rich milk of Jersey or other high-bred stock, and the cream in the same way should be such as is usually sold in the cities, and not too rich, containing about sixteen or seventeen per cent. of fat. The quantity of this food taken by a new-born infant should be two or three fluid ounces every two hours, and if it thrive it will soon take as much as a gill every two hours.

It must be remembered that young infants get a true dyspepsia from starchy foods. Starch is not assimilable by animals until it is converted into glucose, which is accomplished through the action of the salivary and pancreatic secretions, both of which are largely deficient in the infant. This is the great bar to success in artificial feeding, and is the great obstacle to be overcome.

The eruption of teeth is a plain indication of the need of farinaceous and other more substantial foods, but for the first three years of life the diet of a child should be essentially a milk diet.

### Comparative Value of Condensed Milk.

Dr. Edson says: "In canned condensed milk we have an article that fully meets the ordinary requirements of bottle-fed children.

"I am fully aware that writers and *quasi* authorities have very generally condemned this kind of milk, chiefly on account of the large amount of sugar it contains. Most of those who have admitted the value of con-

densed milk for infants have drawn the line between that sold in bulk and that put up in tins.

"As regards canned condensed milk, I am not aware of any instances where it has been faithfully and intelligently used and proved a failure. I do not know of any series of cases in which any constant illness or departure from health has resulted. I have yet to learn of any disease produced by its proper use, or that it fails to sustain and promote the healthy and hardy growth of the infant. I think it remains to be demonstrated that pure sugar, in the quantity used in preserving condensed milk, is in any way unwholesome for the young child.

"In the use of condensed milk, intelligent oversight and pains-taking care are required to guard against gross errors in feeding. The tendency is to use the food too strong. A good formula to begin with is as follows:

Condensed milk, one part.  
Water (temp. 100°), 12-15 parts.  
Lime water, 1-2 parts.  
Salt, a trace.

The strength and quantity should be gradually increased until the third month, when the child may take two teaspoonfuls of milk, twenty of water, and two to four of lime water.

"The great number and variety of surprising mistakes that well-meaning mothers and nurses are capable of making—to say nothing of the lapses of those who are more or less indifferent respecting those under their charge—can scarcely be credited, except by those who have some experience in this matter. I have known mothers, despite positive directions as to quantity, to give at the rate of a twelve-ounce tin of milk in less than two days. It is not rare to find the entire day's supply made up in the morning, in spite of positive directions to prepare the food fresh at each feeding. Indigestion and its various manifestations are the inevitable result of such unwisdom in preparing any food for children."

#### Rules for Managing the Infant During the Summer Months.

The great increase of sickness and death among young children during the summer months is due largely to ignorance on the part of mothers and nurses. Attention to the following rules would save many a life:

1.—Bathe the child once a day in tepid water. If it is feeble, sponge it all over twice a day with tepid water, or with tepid water and vinegar. The health of a child depends much upon its cleanliness.

2.—Avoid all tight bandaging. Make the clothing light and cool, and so loose that the child may have free play for its limbs. At night undress it, sponge it, and put on a slip. In the morning remove the slip, bathe the child, and put it in clean clothes. If this cannot be afforded, thoroughly air the day clothing by hanging it up during the night. Use clean diapers, and change them often. Never dry a soiled one in the



nursery or in the sitting-room, and never use one a second time without first washing it.

3.—The child should sleep by itself in a cot or cradle. It should be put to bed at regular hours, and be early taught to go to sleep without being nursed in the arms. Without the advice of a physician never give it any *spirits, cordials, carminatives, soothing syrups, or sleeping drops. Thousands of children die every year from the use of these poisons.* If the child frets and does not sleep, it is either hungry or else ill. If ill, it needs a physician. Never quiet it by candy or cake; they are the common causes of diarrhœa and of other troubles.

4.—Give the child plenty of fresh air. In the cool of the morning and evening send it out to the shady side of broad streets, to the public squares, or to the park. Make frequent excursions on the rivers. Whenever it seems to suffer from the heat, let it drink freely of ice water. Keep it out of the room in which washing or cooking is going on. It is excessive heat that destroys the lives of young infants.

5.—Keep your house sweet and clean, cool and well aired. In very hot weather let the windows be open day and night. Do your cooking in the yard, in a shed, in the garret, or in an upper room. Whitewash the walls every spring, and see that the cellar is clear of all rubbish. Let no slops collect to poison the air. Correct all foul smells by pouring into the sinks and privies carbolic acid or quick-lime, or the chloride of lime, or a strong solution of copperas. These articles can be got from the nearest druggist, who will give the needful directions for their use. Make every effort yourself, and urge your neighbors to keep clean the gutters of your street, or of your court.

6.—*Breast milk is the only proper food for infants.* If the supply is ample and the child thrives on it, no other kind of food should be given while the hot weather lasts. If the mother has not enough, she must not wean the child, but give it, beside the breast, goat's or cow's milk, as prepared under Rule 8. Nurse the child once in two or three hours during the day, and as seldom as possible during the night. Always remove the child from the breast as soon as it has fallen asleep. Avoid giving the breast when you are over-fatigued or over-heated.

7. If, unfortunately, the child must be brought up by hand, it should be fed on a milk diet alone—that is, warm milk out of a nursing-bottle, as directed under Rule 8. Goat's milk is the best, and next to it cow's milk. If the child thrives on this diet, *no other kind of food whatever should be given while the hot weather lasts.* At all seasons of the year, but especially in summer, there is no safe substitute for milk, if the child has not cut its front teeth. *Sago, arrowroot, potatoes, corn flour, crackers, bread, every patented food, and every article of diet containing starch, cannot, and must not, be depended on as food for very young infants.* Creeping or walking children must not be allowed to pick up unwholesome food.

8.—If the milk is known to be pure, it should have one-third part of hot water added to it, until the child is three months old; after this age the proportion of water should be gradually lessened. Each half pint of this food should be sweetened, either with a dessert-spoonful of sugar of milk, or with a teaspoonful of crushed sugar. When the heat of the weather is great, the milk may be given quite cold. Be sure that the milk is unskimmed; have it as fresh as possible, and brought very early in the morning. Before using the pans into which it is to be poured, always scald them with boiling suds. In very hot weather, boil the milk as soon as it comes, and at once put away the vessels holding it in the coolest place in the house—upon ice, if it can be afforded, or down a well. Milk carelessly allowed to stand in a warm room soon spoils, and becomes unfit for food.

9.—If the milk should disagree, a tablespoonful of lime water may be added to each bottleful. Whenever pure milk cannot be got, try the condensed milk, which often answers admirably. It is sold by all the leading druggists and grocers, and may be prepared by adding to ten tablespoonfuls of boiling water, without sugar, one tablespoonful or more of the milk, according to the age of the child. Should this disagree, a teaspoonful of arrowroot, sago, or corn starch, may be cautiously added to a pint of the milk, as prepared under Rule 8. If milk in any shape cannot be digested, try, for a few days, pure cream, diluted with three-fifths or four-fifths of water—returning to the milk as soon as possible.

10.—The nursing-bottle must be kept perfectly clean; otherwise the milk will turn sour, and the child will be made ill. After each meal it should be emptied, rinsed out, taken apart, and the nipple and bottle placed in clean water, or in water to which a little soda has been added. It is a good plan to have two nursing-bottles, and to use them by turns. The best kind is the plain bottle with a rubber nipple and no tube.

11.—Do not wean the child just before or during the hot weather; nor, as a rule, until after its second summer. If suckling disagrees with the mother she must not wean the child, but feed it, in part, out of a nursing-bottle, on such food as has been directed. However small the supply of breast milk, provided it agrees with the child, the mother should carefully keep it up against sickness; it alone will often save the life of a child when everything else fails. When the child is over six months old, the mother may save her strength by giving it one or two meals a day of stale bread and milk, which should be pressed through a sieve, and put into a nursing-bottle. When from eight months to a year old, it may have also one meal a day of the yolk of a fresh and rare-boiled egg, or one of beef or mutton broth, into which stale bread has been crumbed. When older than this, it can have a little meat finely minced; but even then milk should be its principal food, and not such food as grown people eat.



### Exercise for the Infant.

The first attempts at exercise by the infant are seen in the various awkward movements of the arms, and the stamping with the legs. These are needful motions for the promotion of its health and its proper development, and they should not be interfered with by using such dress and positions as to restrain them. The child should daily be placed upon a mattress divested of all such clothing as constrains its motions, and allowed to enjoy a healthful series of kicks and gymnastics. In summer air should be admitted freely during this system of exercise. This is the only active exercise the infant is capable of taking. Passive exercise, such as carrying in the arms, or riding in an easy carriage, has a salutary influence on the child's health and vigor. This must be commenced as early as the third or fourth day, and kept up regularly as one of the indispensable duties of nursing. Care must be used not to permit the child's body to be carried in an erect position, for fear of an evil effect upon the soft and pliant bony system. The nurse should see that the child is changed from arm to arm in carrying, for the same reason that no undue pressure or force may be produced upon one side of the infant's body. It is not best to encourage a sitting posture until the third month. For even six months the head of the infant should, in carrying, be supported by the nurse's hand.

All rapid, concussive movements are bad for the child. Running or jumping with an infant in the arms, descending rapidly a flight of stairs, jilting upon the knees, tossing rudely in the arms, are all wrong and fraught with danger. Gentle and cautious tossing on the arms affords an agreeable exercise of the body, and may be salutary by the moderate agitation which it causes in the internal organs.

Quite a controversy has been carried on as to the propriety of using cradles for infants. While rude and constant rocking may do harm, especially with infants predisposed to diseases of the brain, gentle and cautious rocking can do no harm. It is the happy mean to be obtained in the application of hygienic laws.

Riding in the carriage may be open to a similar objection as the cradle, if left to the careless conduct of a servant. The carriage should not be pushed along with great rapidity, without any attention to the roughness of the way. The carriage should be sufficiently long to permit the infant to lie at full length; the sides high enough to prevent its falling out. Low wheels should be used to lessen the liability of oversetting.

After the infant has acquired sufficient strength to support itself in a sitting posture, it will be well to place it on the carpet a few times a day, with toys within easy reach. This will give free use of the limbs, and teach it to crawl. A child should be allowed to crawl freely, making this the easy and natural preliminary muscular effort to walking. The too common practice of forcing the walking process by supporting the



child on its legs and leading it forward, is objectionable, causing not infrequently bent limbs, curved spine, and round shoulders. Teach the child, then, to crawl before it walks; and in good weather there will be no objection to the child's being carried out and placed on a grass plot, where it can range about in various directions. Let the rule be to teach the infant gradually and cautiously the art of walking. In this way not only will a firm step and well-formed limbs be acquired, but the dangers of dislocations, painful injuries, as well as the mishaps mentioned above, be obviated. Nurse-maids, too indolent to carry the infant, when unobserved, will place a child just learning to walk on the ground and drag it along by one arm in the most careless manner. This should be most earnestly forbidden. A child should not be raised from the ground by both arms and swung about in the air. Fractures and other serious accidents have occurred in this way. When children have learned to walk, it is the best exercise they can take. In this way they secure a fine physique, and obtain the indispensable fresh air. "At no period of life are the effects of confinement in stagnant and impure air more obviously and lastingly detrimental to the animal economy than during the feeble and susceptible age of childhood. How deeply pernicious a foul and confined air is in its influence on the human system, is most strikingly illustrated in the pale, feeble, and sickly aspect of those unfortunate children who are early placed in manufacturing establishments, where they are confined nearly the whole day in crowded and ill-ventilated apartments. Children brought up in the crowded and filthy parts of large cities, seldom exhibit a perfectly healthy and vigorous appearance."

As intimated before, this exposure of infants to pure air should begin in a very few weeks after birth; an hour or two a day at first, but daily whenever the weather permit. They soon evince a strong desire for the open air. When yet carried by the nurse they point to the door; when crawling they try to approach it; when walking they attempt to escape from the house to the air without. This, however, must not be construed into advice to carry out the child in unfavorable weather or for a long time, with an idea of hardening it. Catarrhal inflammations are easily produced in children.

When old enough to play and romp, the dress should not be so fine as to require an order of good care. Nothing affords more real enjoyment to children, and at the same time tends more decidedly to give them a sound and active tone of mind and body, than a liberal indulgence in exercise and their innocent sports out of doors. Too often children are sent out to show, not to breathe in air and to exercise lungs and limb. In cities children should often be taken to squares and parks, to obtain pure air and to promote the salutary tendency these little excursions seem to have. In earlier years of infancy and childhood no difference should be observed in the freedom of exercise and amusement in the open air

between boys and girls. Mothers fear even for such young girls that the sun will make their skin dark and harsh. Girls, like boys, ought to be freely and frequently exposed to the open air and weather, which will extend its salutary influence throughout the whole subsequent period of life. Children should be cautioned, however, to avoid sitting or lying down on the cool and damp ground, or in a draught of air, after violent running. They should not drink cold water too freely or frequently while in a heated condition.

### What to Observe in a Child.

The most important points to be attended to in making up an opinion of a child's condition, are the countenance, noting its expression, coloration, wrinkles, etc.; the sleep; the cry; the state of emaciation or fatness; the condition of the skin, as to eruptions, color, temperature, degrees of dryness, swelling, etc.; the pulse; the respiration; the signs furnished by the mouth and throat; the power of sucking; and, finally, the state of the abdomen.

### Table of Pulse Rate of Children.

|                                     |                           |
|-------------------------------------|---------------------------|
| Young infants . . . . .             | 100 to 102.               |
| First year . . . . .                | 115.                      |
| Second year . . . . .               | 118.                      |
| Second to sixth year . . . . .      | Sleeping, 76; waking, 92. |
| Sixth to ninth year . . . . .       | Sleeping, 73; waking, 90. |
| Ninth to twelfth year . . . . .     | Sleeping, 72; waking, 80. |
| Twelfth to fifteenth year . . . . . | Sleeping, 70; waking, 72. |

In girls the rate is about five beats higher.

### Table of Temperature of Children.\*

1. The daily range of temperature is greater in the healthy child than that recorded in healthy adults, amounting to 1, 2, or 3 degrees.
2. There is invariably a fall of temperature in the evening, amounting to 1° to 3° F.
3. This fall may take place before sleep begins.
4. The greatest fall is usually between 7 and 9 P.M.
5. The minimum temperature is usually observed at or before 2 A.M.
6. Between 2 and 4 A.M. the temperature usually begins to rise, such rise being independent of food being taken.
7. The fluctuations between breakfast and tea time are usually trifling in amount.
8. There seems to be no very definite relationship between the frequency of the pulse and respirations, and the amount of the temperature; the former being subject to many disturbing influences.

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\* Meigs and Pepper on the Diseases of Children.

### Respiration in Children.

The respiration and the pulse of a child must be investigated while the child is still and quiet. In the young infant it should be done during sleep. This is the only way certain and reliable results can be obtained. The rate of respiration differs greatly at different ages. The average frequency of the breathing in new-born children, and during the first week of life, is thirty-nine times per minute. It may rise, however, upon very slight disturbances, to fifty, sixty, or eighty. In perfectly healthy infants during sleep the respiration may fall to twenty-five per minute.

Between 2 months and 2 years the average number of respirations per minute is 35.

Between 2 years and 6 years the average number of respirations per minute is 23.

Between 6 years and 12 years the average number of respirations per minute is 22.

Between 12 years and 15 years the average number of respirations per minute is 20.

It will be seen that after the age of two years, the rate of the respiration is nearly the same throughout the remainder of the period of childhood; the same average will answer for all practical purposes all through that period.

A peculiar feature of the breathing of young infants is, that it is largely abdominal, the walls of the chest being almost motionless. During sleep the breathing of a young child is soft and regular, and perfectly noiseless; when awake it is quite different from that of an adult, being short, irregular, uneven, and now and then a pause, followed by hurried movements of respiration. After two years the breathing becomes more like that of adults—even and regular.

In all inflammatory conditions of the lungs the breathing is quickened. In severe pneumonia and capillary bronchitis, it becomes very rapid.

There is a kind of breathing frequently seen in sick children which is indicative of great oppression and also of great danger. It is called the *expiratory* respiration. The little patient makes at first a violent and labored expiration, bringing into a kind of convulsive action all the expiratory muscles of respiration; instantly after the expiration follows a rapid and full inspiration; then occurs a momentary pause, and again the respiratory act begins with the labored expiratory act.

### Evacuations of a Child.

The healthy motion varies from a light orange yellow to a greenish yellow, and in number, from two to four times daily.

Smell should never be offensive. Slimy, mucus-like, jelly motions indicate worms. Offensive, acid, pale-green motions indicate a disordered stomach. Dark-green evacuations indicate acid secretions and more serious stomach or bowel disorder.

Fetid, dark-brown stools are present in chronic diarrhoea. Putty-like, pasty passages are due to acidity curdling the milk or to torpid liver.



### General Signs of Health in the Infant.

A child healthy from birth ought to have attained a certain size and development at a certain age. It should not at the third month look like a new-born child, or at the twelfth month like one of six months. This applies also to the degree of fatness. Rotundity is the beauty of youth. Dr. Meigs says of a healthful child: "Its tissues are firm and solid, its surface of a cool and pleasant temperature, its coloration of a clear and exquisite white, firmly tempered with a faint rosy tint in a warm atmosphere, or slightly marbled with light bluish spot in a colder air. Few marks more certainly indicate a healthful temper of the constitution than the clear and exquisitely tinted pink color of the palmar and plantar surface of the hands and feet of a young child. Nothing, indeed, can be more beautiful or perfect in shape or contour than the figure of a fine, hearty young child; nothing more pleasing to the eye than its delicate but vivid coloring; and nothing more expressive of the fullness of health and vitality than its whole appearance." If, instead of these marks, we find emaciation, soft tissues, a dingy tint to the complexion, pallid or bluish feet and hands, listless movements, we can rest assured something is interfering with the machinery of life.

The movements and gestures of a child give a clue to its condition. Healthy children are, when awake, almost always in motion. Even young infants are, when awake, constantly moving their limbs. If the child is laboring under disease of any kind, the disposition to movement is gone. The free and spontaneous movements of health are replaced by the sudden, impatient, and causeless tossing on the bed or lap. Extreme restlessness, constant tossing, or the desire for change, first to the bed then to the arms, is a very bad sign. Among the important gestures we would call especial attention to the frequent carrying of the hand to the head, or to the ear, as indicative of headache or earache. Children have earache oftener than usually supposed. The constant thrusting of the fingers into the mouth indicates pain of dentition. Convulsions are generally heralded by twitchings and irregular movements of the muscles.

## HYGIENE OF THE AGED.

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IN olden times the alchemists claimed to have discovered the elixir of life. They said that old age might be retarded and life greatly prolonged by means of an elixir having the power of preventing or suspending physical decay.

The possibility of prolonging life has in all ages been noticed by great thinkers.

The latest scientific knowledge in regard to this subject may be stated as follows: The principal characteristics of old age, as demonstrated by anatomical research, are a deposition of fibrinous, gelatinous, and earthy material in the system. Every organ of the body, during old age, is especially prone to ossific deposits. The earthy deposits have been found to consist primarily of phosphates and carbonates of lime combined with other calcareous salts.

Man begins in a gelatinous and ends in an osseous or bony condition. From the cradle to the grave a gradual process of ossification is undoubtedly present; but after passing middle age the ossific tendency becomes more markedly developed until it finally ushers in senile decrepitude. These earthy deposits during old age materially interfere with the due performance of function by the organs; hence we find imperfect circulation in the aged; the heart gradually becomes ossified; the large blood-vessels blocked up with calcareous matter, and nutrition hindered.

"If repair was always equal to waste, life would only terminate by accident." It is the opinion of eminent scientists that the majority of all who pass sixty-five years suffer more or less from these ossific deposits. Therefore, bearing these facts in mind, it is plain that the real change which produces old age is, in truth, nothing more nor less than a slow but steady accumulation of calcareous matter throughout the system; and it is owing to these deposits that the structure of every organ is altered, elasticity thus giving way to senile rigidity. Blockage of various organs is thus commenced, and sooner or later a vital part becomes involved, and death of necessity follows. The idea that old age was brought about simply, or at all, by a decline of the vital principle, has long since been discarded by scientists, and the true cause found to be that of gradual disintegration of the tissues because of the inadequate supply of blood.

The feebleness of old age, therefore, being due to nothing more nor less than ossific deposits, it is well for a moment to look for the causes and influences leading to the condition described.

### **The Causes of Old Age and their Avoidance.**

The two principal causes of old age are, first, fibrinous and gelatinous substances; and second, calcareous deposits. According to recent researches, the origin of the first, the fibrinous and gelatinous, may undoubtedly be traced to the destruction of atmospheric oxygen.

Although unquestionably fibrin nourishes the organs of our body, yet it becomes at times, as we reach the cool and shady walks in the evening of life, accumulated in redundant quantity, blockading the streams of life as do the chilling winds of winter the mountain rivulets.

The calcareous deposits are proved to be caused by gradual deposition from the water which forms so large a part (70 per cent.) of the human system, and to be introduced by means of food.

As a matter of fact, everything we eat does contain these calcareous matters to a greater or less degree. The cereals are found most rich in them; so bread itself, the so-called staff of life, except in great moderation, most assuredly favors the deposition of these salts in the system. The more nitrogenous our food, the greater its percentage of calcareous matter: thus a diet composed principally of fruit, from its lack of nitrogen, is best adapted for preventing or suspending ossification.

Moderation in eating, then, must ever be of great value as an agent for retarding the advent of senile decay. Large eaters more rapidly bring on ossific deposits by taking in more than is utilized or excreted, naturally resulting in blockading the vessels and destroying their normal functions. According to the best authorities, the following seem to be the best articles of food as containing the least of earthy salts: Fruit, fish, poultry, flesh of young mutton and beef; because, as before stated, they are much less nitrogenous. Fluids, as part of the diet, is of special import. All well and spring water contains considerable of the earthy salts, and should therefore be avoided, and cistern water used in its stead, because water is the most universal solvent known. Therefore, if when taken into the system clear of foreign matter, it is to that extent the better prepared to dissolve and take up those earthy salts and convey them out of the system. The addition of fifteen or twenty drops of dilute phosphoric acid to the glass of water, and drunk three times a day, will add to the solubility of these earthy salts.

### **Rules for the Care of the Aged.**

1. The aged should not endeavor to perform the feats of agility, strength, endurance, and "of digestion," which were once their pride, especially during the extreme heat of summer.



2. The aged should avoid torpor of the bowels and constipation. Straining at stool may cause apoplexy.

3. Do not give up all mental and bodily work.

4. In the chill of any evening, or of early autumn, the aged need fire. Many an otherwise long life is cut short from neglect of this rule, by an attack of some form of lung inflammation.

5. Life can be prolonged, without a doubt, by a proper change of climate and of scene. The flickering flame of life can be protected from going out by a careful hand.

6. All warnings of weakness, or on-coming sickness, or decay, should at once be noticed by the aged, and due precaution and proper treatment instituted at once.

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## THE CARE OF THE EYES.

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To take proper care of the eyes is to do all we can to avoid such diseases as are avoidable. To do this we should know something about the eye and its diseases, descriptions of which are given in the first part of this book.

### Test of Eyesight.

Boys often discover their near-sightedness by finding that their playmates can read signs, and see clocks and faces, at much greater distances than they can. If any, who are not near-sighted, wish to compare their powers of vision, they can find convenient tests in the heavens at night.

Almost everybody knows the constellations of the Great Dipper and Pleiades. Both of these furnish tests of the range of vision. In the latter, a good eye can readily distinguish six stars; one of higher power can detect eleven; one of extraordinary power can pick out thirteen or fourteen. A telescope brings from fifty to a hundred within easy range.

The middle star in the handle of the Great Dipper has a companion star, which a good eye can make out. There is also a third and fainter star, which demands superior vision to detect. Very strong eyes can pick out some of the moons of Jupiter, particularly when two of them happen to come into conjunction.

While the winter sky is bright and favorable, any reader can make the test. Near-sightedness is a growing defect among young people, and may be corrected in part by looking at distant objects in the heavens or on the ocean.

### Weak Sight.

Fatigue of the eyes during or after the use of them is the first symptom of weak sight. This is more noticeable at first after reading, writing, or sewing in the evening; soon the same fatigue is noticed after similar occupation in day time. In time this fatigue comes on immediately after attempting to read or sew, and, if work is continued, pain and confusion of vision follow; letters run together, lines are blurred and indistinct. Weak sight is simply a disorder of the muscular apparatus of the eyes.

There are four striking symptoms by which we may judge that the eyes are being injured:

1. Redness of the eyelids and balls.
2. Pain in the eyes.
3. Indistinct or imperfect vision.
4. Frontal or other headaches

In health the muscles act in perfect harmony, but if these muscles are overworked, fatigued, or sensitive, they do not act harmoniously, and weak sight is the result. Other beside local causes may produce this effect. Any general ill-health, during convalescence from long fever, or any cause depressing the tone of the constitution, may indirectly affect the eyes, for the eye muscles share in the general weakness of the body, and any misuse of the organs of sight will result in harm. There is a good rule, "Never use the eyes unless they are abundantly supplied with good blood." During sickness, or when in a state of exhaustion, the eyes are not supplied with the best quality or amount of blood, and great harm can come from too free use of them during such times.

### Weak Sight due to Imperfect Light.

Another good rule is, *never use an imperfect light*. What is an imperfect light?

1. Deficient amount of light, as in the early morning or twilight, or an artificial light far distant, or a very small artificial light, or light far from a window, which is too small for the room and for a dark day. When the light is such as to render it difficult to see the work or print before us, a proper regard for the preservation of vision will compel the immediate stopping of the work. Of course, there are different kinds of work requiring different amounts of light, but the general rule just stated will hold good.

2. Light may be imperfect from its unsteadiness. It is this quality that renders the electric light harmful to vision. Gas light often exhibits a degree of flickering very trying to the eyes.

3. The light may be steady, but the car or carriage in which we are seated may move. The attempt to read in the cars is a fruitful source

of injury to the eyes. Some of the worst cases of muscular weakness of the eyes have been derived from this cause.

4. The practice of reading while in a reclining position upon a lounge or in a bed causes the light to enter the eye at such an angle as to require an undue amount of effort in order to see distinctly for a long time. Such a position should always be avoided.

When possible, the light should fall upon the printed page or upon our work from the left side of the body, and from behind the shoulders. In this way the movements of the right hand least obstruct the light and the rays are reflected with greatest directness from the page to the eye.

### **Rules for the Preservation of Good Sight.**

The way to obtain and maintain the best eyesight may be summed up in these plain propositions:

1. Act as if the eyesight were of more importance than any other thing on earth.

2. Have every child's eyes carefully examined by an expert before it is given specific tasks to perform calling for the full exercise of healthy eyes. If the eyes are found defective, then grade the tasks according to the nature of the defect.

3. Never use the eyes when such use causes pain in these organs or in the head.

4. Never use the eyes when imperfectly supplied with blood, as before breakfast, when exhausted after a severe illness, etc.

5. Never use the eyes for close work in an imperfect light.

6. Avoid the excessive use of alcohol and tobacco.

7. Heed the warning given by redness of the eyelids, and of the whites of the eyes; by pain in or about the eye; by the continuance of indistinct vision for any considerable time.

8. Regard the eyes as a part of a very complex system of apparatuses, the best health of all being absolutely needful for the best health of each.

9. Remember that we do not see with the eye, but with the brain. Hence after the brain is exhausted it is impossible to really see. Hence the absurdity, as well as perniciousness, of any endeavor to see after the brain is exhausted. Especially is this true of young and growing brains. It is well to remember that the normal brain continues to grow until about the age of forty.

### **The Use of Spectacles and Eye-Glasses.**

Weak sight is very often due to defective form of the eyeball itself, it being too flat, too full, or of irregular form. The large majority of eyes are more or less imperfect in form, and this explains the prevalence of sight weakness. In cases of defective eyeballs, beside following the advice given above, the imperfect shape must be neutralized by the scientific



adaptation of spectacles. It is quite wrong to depend upon your own judgment in this matter, or to procure your glasses from a traveling pedlar of spectacles.

For elderly people, spectacles are usually preferred to eye-glasses, but for occasional use, eye-glasses, attached to the clothing by a suitable cord or small chain, are always at hand, and may be quickly adjusted. For long use, spectacles are more comfortable.

Blue or smoked glasses are useful in weak sight, when there is much dread of light; but unless really necessary, the eye may become so habituated to a subdued light by the constant use of colored glasses as to be intolerant of ordinary light. Their use should be confined chiefly to wear in bright sunlight on the snow, sand, or water. For reading, colored glasses should not be too dark in tint, as too much exertion is required to see clearly through them.

#### Contagious Eye Diseases.

It should be borne in mind, that diseases of the lids or eyes attended with a pus discharge are contagious. Those suffering with such a disease should be kept apart from others, and great attention should be paid to cleanliness. Towels and washing material should not be used in common.

#### Disease of the Eyes of New-Born Infants.

Young babies are quite subject to a severe inflammation of the eyes, usually making its appearance in a few days after birth. There is great swelling of the eyelids, and a copious purulent discharge, which is highly contagious. This affection is very dangerous to the sight, and therefore the very best medical aid should be secured. It will not be amiss, however, to caution the great care that should be used as regards cleanliness, and the avoidance of any of the matter coming in contact with healthy eyes.

#### Common Eye Accidents.

Those who work where splinters of metal or stone are liable to strike the eye should wear spectacles at their work.

Spectacles of ordinary glass are a good protection against cinders in traveling. *Eye stones* are nothing but smoothly-worn pebbles. *It is not best to use them.* It is not common-sense treatment to cure an irritable eye, suffering from a foreign body, by placing another foreign body therein.

A cinder, or other foreign body, may often be displaced by quietly and steadily looking downward at your feet, letting the tears that form wash out the irritating substance. If the foreign body sticks on the ball, it sometimes can be readily wiped off with a piece of paper twisted to a lamp-lighter shape, or the free end of a common match. If it does not come off easily, professional aid must be secured, as great harm may be done the beautiful, transparent front of the eye by the use of sharp instruments in unskilled hands.

If quick-lime or mortar has fallen into the eyes, the best plan is to drop in some olive oil at once. The eye then may be washed out with warm water, to wash away all the particles of lime. This can be best done with a small syringe. If acid has gotten into the eye, use milk and water at once, and in the same manner.

Children are fond of exploding caps with a stone or hammer. This is a very dangerous sport. A piece of exploded percussion-cap entering the eye is usually fatal to the injured organ.

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## CARE OF THE EAR.

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The general advice as to the care of the ears is quite similar to that given under the subject of care of the eyes.

1. Act as if hearing were of more importance than any other thing on earth.

2. Refrain from use of the ear when it causes pain, choosing quiet places and deadening sound by the use of cotton plugs.

3. Avoid all such injuries to the ears as result from slapping, pulling, and very loud and sudden noises.

4. Keep out of the external ear all things smaller than the forefinger, or stiffer than a towel or handkerchief.

5. Keep out of the ear all oils, all soaps, all cold water, and everything else recommended by kind but mistaken friends; especially never apply a poultice to the ear for the relief of pain. Dry heat will do all that moist heat can do to relieve, and be free from the danger of absolutely destroying, the drum of the ear.

Rules 8 and 9, under the subject of care of the eyes, apply with the same force to the care of the ear. Dr. Van Harlingen remarks upon the hygiene of the ear as follows: "All attempts to clean the deeper portions of the outer passage of the ear by means of ear-spoons and other contrivances, are unnecessary, and sometimes give rise to inflammation. In health, the deeper parts of the ear can be left to take care of themselves. The orifice of the canal is to be cleansed in precisely the same manner as any other depressed portion of the surface of the body—that is, with a wet sponge or cloth. Bathing in salt water may injure the ear in two different ways. The water may gain an entrance into the external canal, and by its irritating properties set up an inflammation. I am disposed, however, to believe that in the great majority of cases the disease is caused in another way. In the manœuvres incident to diving, swimming under water, floating on the back, etc., the nasal passages become filled

with salt water. The bather then yields to an almost irresistible desire to blow his nose, in order to get rid of the irritating fluid. The blowing is generally of a vigorous character, and often forces some of the salty fluid up through the nasal passage (Eustachian tube) which leads from the back part of the nose to the drum cavity, where its presence may give rise to even very severe inflammation. If the bather is careless, or not familiar with the surf, his ears may receive injury from the mere impact of the waves. What can be done to avoid these injurious effects of bathing? After the bath, abstain from blowing the nose in any but the gentlest manner until after all the active secretion of mucus has ceased." It is considered advisable to wear cotton in the ears during bathing if the bather has an irritable skin, or has had some affection of the ear canal, or if he knows that his drum-head is perforated; otherwise the protection afforded by the cotton is too slight to compensate for its annoyance.

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## CARE OF THE SKIN.

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Every-day washing should be the rule the year round, but particularly so in summer. Ablution of the person sufficient for cleanliness may easily be made to act also as a proper stimulant by using a rapid sponge bath, followed by quick rubbing for a few moments with a towel of such texture as can be borne without irritation. The skin will not bear the frictions of a lintish towel so well in summer as in winter. Invalids should avoid chilling the body: simple and generally healthful as bathing is, it cannot be trifled with. Many a good man or woman has unwittingly committed suicide with water. Mankind is disposed to abuse and misuse almost every good thing. If the person is very feeble and very sensitive to the application of water, such a one can attend to one part of the body one day and another the next. It is well, however, to give daily attention to the feet. The feet perform a large part of our bodily labor, and the excretion from them is so great that particular care should be taken to keep them clean. Warm sponging followed by friction is more suitable for cleansing the skin of dirt, and for the delicate invalid and child. The cold bath in the tub, as the same in the river or sea, needs much more caution as to the condition of the system, the time and circumstances, than the sponge bath needful for cleanliness and health. Only those who daily use the morning sponge bath can imagine the glow, invigoration and general good feeling that come from it.

The tepid or warm tub bath may, with proper care, be occasionally



indulged in as a luxury, and may be made a means of cure for the ill, or a preventive for one threatened with disease. The vapor bath, the hot bath, and the so-called Russian—in which more extreme changes of temperature and perspiration are gone through—all require much more care and skill in their use than the more simple kinds, and without this skill and care much more harm than good may accrue. The air bath, or a short exposure to the air and sun, accompanied with a degree of friction, or if the atmosphere be warm a longer exposure to the sun, is salutary ; and, like a frequent change of clothing and the exposure of the naked body to the dry heat of a fire for a few moments, is beneficial. Whatever stimulates gently the skin without irritating, chilling, or inducing much perspiration, invigorates it and prepares it to resist disease.

Soap.

The amount of soap used in the toilet depends upon the delicacy of the skin and the exposure to which it has been subjected. Those who have oily skins, particularly about the face and shoulders, depending upon well-developed and active oil-glands, require much more soap than those having harsh and dry skins lacking in oily secretion.

A good soap should be composed of caustic soda and refined animal fat, or the best olive oil, to which perfume may be added. Too often strong perfumes are added to hide the evil quality of a soap, made, perchance, of rancid fats and various oily refuse. Opaque and mottled soaps are more easily adulterated by the makers than pure white or transparent soaps. Good *white* castile soap, or a transparent soap, should be, therefore, the kind selected.

Cosmetics.

Cosmetics are substances applied to the skin, hair, teeth, nails, etc., to improve their appearance. None of them are essential to health ; some are positively harmful. A number of cases are on record of poisoning from the use of face powders. Such powders as contain lead are the most dangerous. To remove the shine of the skin in hot weather, a little powder may be allowable, but the simplest, and such as is made at home—as powdered starch or rice flour—only should be used.

Formula for a Toilet Cologne.

|                                                      |             |
|------------------------------------------------------|-------------|
| Oil of bergamot . . . . .                            | 4 drachms.  |
| Oil of lemon, oil of orange, lavender, of each . . . | 1½ drachms. |
| Oil of cloves, neroli, of each . . . . .             | ½ drachm.   |
| Oil of cinnamon . . . . .                            | 15 drops.   |
| Deodorized alcohol . . . . .                         | 3 pints.    |
| Rose water . . . . .                                 | 6 ounces.   |

## CARE OF THE HAIR.

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The first requisite in the management of the hair is cleanliness. The outer skin of the scalp, like that of the body, is constantly being thrown off in the form of small white scales. The oil-glands of the scalp are active and supply the hair with an abundance of natural oil, serving to keep it in a glossy condition, but at the same time making it liable to catch dust and dirt. The head and hair, like the skin of the body, must be kept clear of dirt, and the best way to accomplish this is to brush them often and thoroughly with a *soft* brush. The scalp should receive full attention; the brushing of it tends to induce proper action of the oil-glands, and thus the hair is kept in better condition than with the use of pomades. These should only be used in case of such persistent dryness of the hair as prevent its being properly dressed.

When the hair is short, there is no objection to the free use of cold water morning and evening, rubbing the scalp briskly afterward with a coarse towel. In the case of a female, or where the hair is long, washing is only occasionally required, but frequent brushing is necessary to keep the hair clean and in good condition.

The best wash for the hair during the cleansing process is castile soap and water, or borax and water. It should be borne in mind that some ladies suffer from attacks of neuralgia of the head after imperfect drying of the hair. When water is allowed to dry in the hair, a decomposition of the natural oil takes place, and gives rise to a peculiar and quite disagreeable odor. Dipping a brush into a little powdered starch and brushing it well into the hair, and then brushed out again, will assist in drying long hair after washing.

The improper use of the comb can do much harm. It should never be used to scratch the scalp. The comb is meant to separate the hair, to make the part, and to prevent matting. A fine-toothed comb should be used with great care. If brushing will not remove the collected dandruff, then it should be *washed* out, not *combed* out.

It is better to keep the hair of children cut short, for the sake of comfort, convenience, and cleanliness. After the hair has once been allowed to grow long in girls, it is better not to cut it, for, in the opinion of the best authorities, the hair never afterward grows to the length which it would otherwise have attained.

Crimping the hair causes it to break and crack. This may be a matter of considerable importance in elderly women in whom the hair is beginning to fall and thin out, for this will hasten the fall, and cause more or less baldness.

Women usually preserve the color of the hair longer than men. Fair hair falls out sooner than black, but does not become gray so soon. Premature grayness of the hair is often produced by debility, anxiety, or severe illness. The causation of baldness may be described as follows: "Each hair grows from its papilla within the skin, lives its life (from two to four years in healthy persons) and then dies and drops out, to be succeeded by another, as certain annual plants grow year after year from the same bulbous root and die down again. If, from any cause, the hair papilla becomes diseased or debilitated, it either ceases to produce the hair, or each successive hair becomes shorter, finer, and more brief in its life, until, finally, atrophy of the hair follicles occurs, and the hair is dead. Under ordinary circumstances the hair of the head begins to thin out between the ages of thirty and forty, and this thinning proceeds slowly but steadily during the rest of the individual's life." Those who are affected with dandruff should pay immediate attention to the condition, otherwise the hair will begin to fall out and baldness result. Baldness can occur without the occurrence of dandruff, and, again, the hair remains thick and strong in some persons whose heads are full of dandruff. This is an exceptional condition, and does not prove, as some think, that dandruff in the scalp is a sign of peculiar vigor of the hair.

The baldness occurring in connection with fevers, skin diseases of the scalp, etc., is only temporary; the bulbs are not destroyed, and the hair is again reproduced. In elderly persons, after sickness, the hair may not return to its full former condition.

When the falling of the hair has been caused by some fever or other illness, the remedies used for relief are stimulants—something to increase the blood supply to the scalp. These are called hair invigorators. We would caution the reader against the use of all patent, advertised hair remedies. A simple and harmless "invigorator" is as follows:

**Formula for a Good Hair Invigorator.**

|                                                      |            |
|------------------------------------------------------|------------|
| Cologne water, . . . . .                             | 2 ounces.  |
| Tincture of cantharides, . . . . .                   | 2 drachms. |
| Oil of lavender, oil of rosemary, of each, . . . . . | 10 drops.  |

Use once or twice a day. If it makes the scalp a little sore, discontinue its use for a short time.

*To Make the Hair Grow.*—Simmer one ounce of rosemary herb until of a dark green color; then, to each quart of liquid add half a pint of rum. If the hair is inclined to dryness, a little oil may be added. One ounce of tincture of cantharides to the quart of the liquid is a useful addition.



*To Cleanse the Hair of Dandruff*.—Rub in well the yolk of an egg. Wash out with castile soap, rinse with cold water, and dry well. Use some nice oil or pomade afterward. The egg combines with the grease and dirt, and gives the scalp a thorough cleansing.

#### A Good Wash for the Hair.

|                               |                      |
|-------------------------------|----------------------|
| Vinegar . . . . .             | 2 ounces.            |
| Salt of tartar . . . . .      | 2 drachms.           |
| Spirits of lavender . . . . . | $\frac{1}{2}$ ounce. |
| Spirits of rosemary . . . . . | 1 ounce.             |
| Spirits of nutmeg . . . . .   | $\frac{1}{2}$ ounce. |
| Essence of almonds . . . . .  | 1 drachm.            |
| Essence of violets . . . . .  | 1 drachm.            |
| Pure spring water . . . . .   | 20 ounces.           |

Mix and bottle for use. This makes, as well, a cool and refreshing perfume.

Abnormal growth of hair, occurring in females upon the lip or chin, is a very annoying condition. The use of depilatory powders or washes is attended with danger, as all these are of a caustic nature, and while they destroy the outer end of the hair, the root is left intact.

During sickness the hair should receive much attention. It is not necessary to cut it, as a rule. Constant brushing and examination of the scalp should be practiced, and the hair kept from matting. Even in the cleanest persons vermin will come from a few days' neglect; but in such a case the hair need not be sacrificed.

## CARE OF THE TEETH.

Attention to the teeth should begin early in life, even during the period of first teeth. Decay of the "milk" teeth should be prevented, and filling is just as important as with the permanent set. The temporary teeth must be removed in due time, if they do not fall out themselves, and the permanent ones must be trained to fill their places. The teeth should be cleansed five times a day—morning, bedtime, and after each meal. A soft brush is better than a stiff one, so as not to wound the gums. The best dentifrice is *water*; sometimes a little prepared chalk or white castile soap may be used. The too-frequent use of powders containing cuttlefish bone or charcoal will injure the enamel of the teeth. When the gums are tender and tend to bleed, add a few drops of tincture of myrrh to the water. Avoid all patent tooth powders and washes. It is a good rule to visit the dentist once each season, to find out the exact condition of these important organs. Never lose a tooth, if art can save it. The shape of the jaw and

face is altered by the removal of teeth. When, by reason of a collection of tartar on the teeth, a powder is desired for its removal, the following will be found useful and agreeable:

**Tooth Powder.**

|                                 |             |
|---------------------------------|-------------|
| Precipitated chalk . . . . .    | 12 drachms. |
| Rose pink . . . . .             | 2 drachms.  |
| Carbonate of magnesia . . . . . | 1 drachm.   |
| Oil of rose . . . . .           | 5 drops.    |

Mix all well together.

## CARE OF THE MOUTH.

Besides the care of the teeth, the mouth itself should receive some attention. The mucous membrane lining the lips and mouth and covering the tongue, is quite thin, and easily absorbs matters placed in contact with it. It is only reasonable, then, to advise care as to the putting of coins in the mouth, as to promiscuous kissing, and the licking of postage stamps. Even some caution should be exercised as to putting the fingers in the mouth, without washing, after handling books in public libraries, handles of street cars, etc., which are touched by the high and low, cleanly and dirty. This is an argument in favor of the constant use of gloves, and shows that the demands of fashion are often based upon sound philosophy. We trust the day will come when fashion will put a stop to the usual kiss salutation of ladies, and especially the kissing of children by every relative, friend, and acquaintance that happens to come in their company. Sore throats, diphtheria, and even loathsome diseases, are communicated in this way.

Another point in this connection is the use by children of toys which are painted with poisonous dyes, and the eating of colored candy. It is best to select toys of plain wood, and candies uncolored.

## CARE OF THE HANDS.

To prevent the cracking and roughness of the hands, so common in winter, cold water alone should be used, and soap used only sparingly. The hands should not be washed just before going out of doors; but, if

they are washed then, rub in a little good grease, as cosmoline, to prevent the action of the air. Skin gloves, as kid, dog-skin, castor, or buck-skin, should always be worn in cold weather. Silk or woolen gloves are more likely to give rise to chapping. If the hands have become chapped, anoint at bedtime with tallow, cold cream, or cosmoline; put on an old pair of gloves, and in the morning merely wipe off, do not wash, the hands.

*For Whitening the Hands.*—Take a wine-glassful of cologne water, and another of lemon juice, then scrape two cakes of brown Windsor soap to a powder, and mix well in a mould. When hard, it will be an excellent soap for whitening the hands.

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## CARE OF THE FEET.

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Corns and bunions are usually caused by improperly-fitted shoes. The shoe should be shaped in accordance with the proper outline of the foot, and made of pliable and soft leather. Certainly it is plain that the foot must get into the shoe, and if the shoe differs in shape from the foot, the more pliable foot will adapt itself to the shape of the shoe. Fashion has in the past dictated an arbitrary form of shoe. She has really determined that nature made the foot entirely wrong, and has taken it upon herself to change the shape. Now, it holds true of any organ in the body, if we in any way change its form, not only do we not improve, but we actually disfigure it. The function of a shoe is to protect the foot, not to distort its shape.

### In-Growing Toe-Nail.

The cure of this condition—from which so many persons suffer—of the much-abused foot is slow but sure. The foot must be often soaked in warm water, until the soreness is so far abated that it can be handled without much pain; then, with a probe or suitable instrument, pass pledgets of absorbent cotton (plain or medicated with glycerine, or some healing, soothing remedy) as firmly as possible under the most detached point of the nail. The toe should be dressed daily, soaking it with warm water and applying fresh cotton, pressing the same farther and farther under the nail, as may be necessary. When portions of the nail become free, they may be cut off, and mild caustics, as burnt alum, may be applied to remove proud flesh. Scraping the nail in its centre will be an aid to getting the cotton more successfully in its place.

Do not change the shoes of children first to one side, then the other. This is done to make the shoes wear evenly, or prevent their turning over



to one side at the heel. This is a saving of shoe leather at the foot's expense. After one foot has shaped a shoe to itself, a change to the other foot should never be allowed.

It has been recommended that those who are desirous of having their feet natural and healthful should not wear unyielding stockings. There is no doubt that during the growing years stockings can influence the shape of the foot, especially if they are tight, short and narrow-toed, drawing the toes together, and keeping them so. An English author recommends the wearing of stockings with toes, similar to the fingers on a glove.

### Corns and Bunions.

A common corn is caused by friction or irritation of the skin from tight, loose, or otherwise ill-fitting shoes, hard, stiff leather, large wrinkles over the joints, high heels that pitch the foot forward and keep it constantly bearing against the leather over the toes, and shoes narrow at the toes. In such cases the skin thickens and hardens to protect itself from injury, in just the same way that it does upon the hands or other parts of the body exposed to rough contact.

The great cause of bunions is the wearing of short and narrow-toed shoes, making a constant tendency to enlarge, widen, and project the joint of the great toe.

Ordinary hard corns, when young, may be removed by scraping up the callous skin about the borders and prying out carefully with a penknife. It must be remembered, for the successful treatment of corns, proper foot covering must be worn. The shoes must be soft and of proper fit. Only such means can effect a radical cure. Corn cures and plasters are but a vexation if the laws of hygiene are not obeyed. Treat the foot with as much care as the hair, or face, or teeth, and far less will be heard of corns. The radical cure is easy, but few obtain it. Fashion, ignorant shoemakers, custom, and carelessness, combine to inflict upon our most useful members torture and a degree of uselessness. The important part of treating corns is to relieve the pressure. Persons ill with a long fever, confined to their beds, have found their corns gone on getting from bed.

Quite a successful plan of treatment is as follows: Rub the corn twice a day with volatile liniment, and in the interior cover with a corn plaster. Every morning and evening the foot is to be put for half an hour in warm water, and while there the corn is to be well rubbed with soap. Afterward all the soft, white, pulpy matter is to be scraped off with a blunt knife, stopping the scraping, however, the moment pain is felt. If this treatment is persisted in, the corn will be cured in about two weeks. Another method: Soak the corn as above, shaving off the horny substance, then touch with nitric acid. The aqua-regia, nitromuriatic acid is the usual secret remedy of the "corn cures." Some

doctors have advised that the corns be shaved down close, after soaking in warm water and soap, and then be covered with a piece of wash-leather or buckskin, on which lead-plaster is spread, a hole being cut in the leather the size of the corn. They may be softened so as to be easily scraped out by rubbing glycerine on them. In applying acids, only a very little should be used, and applied with some sharp-pointed instrument. This destroys the papilla and changes the structure of the skin, so that the corn never reappears. It is not necessary to burn the surrounding tissues, but only to cause a very small burn, just on the hardened point of the corn.

A bunion is really an inflammation of a sac at the inside of the ball of the great toe. The treatment is soothing; caustics, as a rule, are not allowable, and the deformity is more or less permanent.

The callosities that come upon the heel can be scraped off after soaking in warm water and soap.

The toe nails should be cut regularly and carefully. Overshoes should always be worn in wet weather. Ladies often go without them in damp weather, relying upon the thickness of the soles of their shoes, and thus expose themselves to risks. A sheet of india-rubber is sometimes placed between the layers of leather in the soles of shoes, or felt or cork soles are placed within the shoe. There is no objection to these, providing they do not supplant the rubber overshoes.

## GENERAL HOUSEHOLD RECIPES AND HINTS.

### To Purify Sinks and Drains.

To one pound of common copperas add one gallon of boiling water, and use when dissolved. The copperas is deadly poison, and should

always be carefully labeled if kept on hand. This is one of the best possible cleansers of pipes and drains.

### To Wash Greasy Tin and Iron.

Pour a few drops of ammonia into every greasy roasting-pan, after half filling the pan with warm water. A bottle of ammonia should always be kept on hand near the sink for such

uses; never allow the pans to stand and dry, for it doubles the labor of washing, but pour in water and use the ammonia, and the work is half done.

### To Clean Carpets.

Shake and beat the carpets well; lay them upon the floor and tack them firmly; then with a clean flannel wash them over with one quart of bullock's gall mixed with three quarts

of soft, cold water, and rub it off with a clean flannel or house-cloth. Any particularly dirty spot should be rubbed with pure gall. Carpets cleansed in this way look bright and fresh.

### Treatment of Oilcloth.

Oilcloth ought never to be wetted, but merely rubbed with a flannel and polished with a brush of moderate hardness, exactly

like a mahogany table; and by this means the fading of the colors and the rotting of the canvas are entirely avoided.

**Flannels.**

Flannel should always be washed with white soap, and in warm, but not boiling, water.

**Damp Closets.**

For a damp closet or cupboard, which is liable to cause mildew, place in it a saucerful of quicklime, and it will not only absorb all apparent dampness, but sweeten and disinfect the space. Renew the lime once a fortnight; if the place be very damp, renew it as often as it becomes slaked. Lime may be used in the same way for water-closets and out-buildings.

**Damp Walls.**

Line the damp part of the wall with sheet lead, rolled very thin, and fastened up with small copper nails; it may be immediately covered with paper, and so hidden from view. The lead is not to be thicker than that which lines tea chests.

**Whitewash for Rooms.**

Take four pounds of whiting and two ounces of common glue; let the glue stand in cold water over night, then heat it until dissolved and pour it hot into the whiting mixed with cold water. This makes a nice, smooth whitewash.

**Whitewash that will not Rub Off.**

Mix up half a pailful of lime and water ready to put on the wall; then take one-fourth pint of flour, mix it with water, then pour on it a sufficient quantity of boiling water to thicken it, and pour it while hot into the whitewash; stir all well together and use.

**Painting and Papering.**

Painting and papering are best done in cold weather, especially the former, for the wood absorbs the oil of paint much more in warm weather, while in cold weather the oil hardens on the outside, making a coat which will protect the wood instead of soaking into it.

**Milk Paint.**

Mix water lime with skim-milk to proper consistency to apply with brush, and it is ready for use; it will adhere well to wood, smooth or rough, to brick, mortar, or stone, where oil has not been used, and it forms a very hard substance as durable as the best of paint: any color which is desirable may be had by using colors dissolved in whisky.

**To Clean Brass.**

Finely-rubbed bichromate of potassa, mixed with twice its bulk of sulphuric acid and an equal quantity of water, will clean the dirtiest brass very quickly.

**To Clean Bricks.**

To remove the green that gathers on bricks, pour over them boiling water in which any vegetables, not greasy, have been boiled; repeat for a few days and the green will disappear. For the red wash, melt one ounce of glue in one gallon of water; while hot, add alum the size of an egg, one-half pound Venetian red, one pound Spanish brown: if too light, add more red and brown; if too dark, water. By experimenting, the color desired may be had.

**To Polish Nickel Plate.**

Scour with pulverized borax; use hot water and very little soap; rinse in hot water, and rub dry with a clean cloth. By this quick process a bright polish may be had.

**Cement for Broken China or Glass.**

Dissolve one-half ounce of gum arabic in a wine-glassful of boiling water; add plaster-of-paris sufficient to form a thick paste, and apply it with a brush to the broken parts; being nearly colorless, it is better than liquid glue or other cements.

**To Cleanse Brasses, Tins, Coppers, etc.**

Mix rotten-stone, soft soap, and oil of turpentine to the consistency of stiff putty. The articles should first be washed with hot water to remove grease; then rub the metal with the mixture, mixed with a little water; then rub off briskly with a dry, clean rag or leather, and a beautiful and durable polish will be obtained.



**To Remove Iron Stains from Marble.**

Wet the spots with oil of vitriol, or oxalic acid diluted in alcohol, or with lemon juice, and after a quarter of an hour, rub them dry with a soft linen cloth.

**To Clean Marble.**

Use three ounces of pearl ash, one pound of whiting, and three pints of water well mixed together, and boil for ten minutes; rub it well over the marble and let it remain twenty-four hours, then rub it off, and dry with a clean cloth.

**To Clean Woodwork.**

Where painted wainscot or other woodwork requires cleaning, fuller's earth will be found cheap and useful, and, on wood not painted, it forms an excellent substitute for soap. Where extreme nicety is required, use a mixture of one pound of soft soap, two ounces of pearl ash, one pint of lard, and one pint of table beer; simmer these substances in a pipkin over a slow fire, and let them be well mixed. The mode of application is to put a small quantity in flannel; rub it on the wainscot, wash it off with warm water and dry thoroughly with a linen cloth. This will clean painted woodwork without removing the paint.

**To Clean Gilt Frames.**

When the gilt frames of pictures or looking-glasses, or the gilt mouldings of rooms have specks of dirt upon them, from flies or other causes, they can be cleaned with the white of an egg gently rubbed on with a camel-hair pencil.

**To Clean Picture Frames.**

Black walnut frames will become dull and rusty looking. They may be renewed by first brushing thoroughly with a stiff brush to remove dust, and then applying pure linseed oil with a proper brush, or with a piece of new bleached muslin.

**To Remove Moths from Furniture.**

Moths may be exterminated or driven from upholstered work by sprinkling this with benzine. The benzine is put in a small watering pot, such as is used for sprinkling house-plants; it does not spot the most delicate silk, and the unpleasant odor passes off in an hour or two in the air. Care must be used not to carry on this work near a fire or flame, as the vapor of benzine is very inflammable. It is said that a little spirits of turpentine added to the water with which floors are washed will prevent the ravages of moths.

**Perfume and a Preventive against Moths.**

Take one ounce of Tonquin beans, carraway seed, cloves, mace, nutmeg, cinnamon, well ground; add six ounces of Florentine orris root; mix well, and put in bags among your clothes.

**To Blacken Hearths.**

Mix black lead and whites of eggs well beaten together; with a painter's brush wet the hearth thoroughly all over; then rub it bright with a hard brush.

**To Remove Fly Spots.**

Dip a camel-hair brush into spirits of wine, and apply it to remove fly spots.

**Mucilage.**

An excellent mucilage may be made by taking one ounce of gum tragacanth, as much corrosive sublimate as will lay on a silver five-cent piece; put it into a jar and pour over it one quart of cold, soft water; let it stand twenty-four hours; then stir, and it is ready for use, and it will keep as long a time as is desired.

**Liquid Glue.**

Dissolve 33 parts of best glue, in a steam bath, in 36 parts of water; then add gradually, stirring constantly, 3 parts of nitric acid, or enough to prevent hardening when cool.

**How to Keep Meat.**

Meat is much better for family use when at least one week old in cold weather. Hang up a quarter of meat with the cut end up, the reverse of the usual way, and the juice will remain in the meat and not run to the cut and dry up by evaporation.

### To Restore and Preserve Flowers.

Faded flowers may be generally more or less restored by immersing them half way up their stems in very hot water, and allowing them to remain in it until it cools, or they have recovered. The scalded portion of the stem must then be cut off, and the flowers placed in clear, cold water. In this way a great number of faded flowers may be restored; but there are some of the more fugacious kinds on which it proves useless. Flowers may

also be preserved and their tints deepened by adding to the water a little solution of carbonate of ammonium and a few drops of phosphate of sodium. The effect of this in giving the flowers a deeper color and a stronger appearance is quite wonderful; and, by cutting off every other day about half an inch of the stems of the flowers with a sharp knife, they may be kept as long as their natural life would last in the fields or woods.

## HINTS FOR THE TOILET.

### To Clean Hair Brushes.

Dissolve a piece of soda in some hot water, allowing a piece the size of a walnut to a quart of water; put the water into a basin, and, after combing out the hair from the brushes, dip them, bristles downward, into the water and out again, keeping the backs and handles as free from water as possible. Repeat

this until the bristles look clean; then rinse the brushes in a little cold water; shake them well, and wipe the handles and backs with a towel, *but not the bristles*, and set the brushes to dry in the sun, or near the fire. Wiping the bristles of a brush makes them soft, as does also the use of soap.

### To Clean Combs.

If it can be avoided, never wash combs, as the water often makes the teeth split, and the horn, if wet, often becomes rough. A small

brush can be bought made purposely for cleaning combs; with this the comb should be well brushed, and afterwards wiped with a cloth.

### Bandoline.

Soak starch or Irish moss (whichever is handy) in rose water until dissolved and

smooth; if you wish it to be pink, color it with a little pounded cochineal.

### Oil of Roses for the Hair.

Attar of roses one drachm, oil of rosemary one drachm, olive oil one quart, mixed together.

It may be colored red by steeping a little alkanet root in the oil (with heat) before scenting it.

### Milk of Roses.

Put into a small bottle two ounces of rose water, one teaspoonful of oil of sweet almonds, ten drops of oil of tar. Shake the bottle until

the whole is combined; it makes a nice and perfectly harmless cosmetic to apply to the skin after washing.

### Marrow Pomade for the Hair.

Marrow a quarter pound, lard a quarter pound, castor oil six ounces, salad oil six ounces, palm oil half ounce; scent with oil of berga-

mot; melt the lard and palm oil together, then strain it, and strain the marrow; mix all well together, until nearly cold and put in pots.

### Perfume for Linen.

Lavender flowers half pound (free from stalk), dried thyme and mint, of each, half ounce, ground cloves and carraway, of each, a

quarter ounce, common salt dried one ounce; mix well together, and put into cambric or silk bags.

### Chapped Hands.

Unsalted lard a quarter pound, yolks of two new-laid eggs, rose water to mix well; add a

large spoonful of honey, and enough of *fine* oatmeal or almond flour to work it into a paste.

Chapped Lips.

Borax, benjamin, and spermaceti, of each, a quarter ounce, a pinch of alkanet root, a large juicy apple chopped, a bunch of black grapes bruised, a quarter pound of unsalted butter, two ounces of bees wax ; put all into a new tin

saucepan ; simmer gently till the wax, etc., are dissolved, and then strain it through a linen ; when cold, melt it again and pour it into small pots or boxes ; or, if to make in form of cakes, use the bottom of teacups.

Excessive Sweating of the Hands or Feet.

A useful prescription for excessive sweating of the hands and feet, is : Carbolic acid one part, burnt alum four parts, starch 200 parts,

French chalk fifty parts, oil of lemon two parts ; sprinkle on feet, or inside of stockings or gloves, etc.

Chilblains.

Wash the chilblains with tincture of myrrh | diluted in a little water.

Burns.

Lime water beaten up with sweet oil is an | excellent ointment for painful burns.

Sprains.

Sal ammoniac half an ounce, rose water half pint, cologne water a tablespoonful. Rags

wet with the lotion should be laid on the injured part, and changed when they get dry.

Sunburn.

This may occur in grade from a slight reddening of the face to an inflammation attended with blistering. Soothing applications and avoiding the cause are the indications. Oxide of zinc ointment, cosmoline and zinc ointment, in equal parts, or dusting powders of

starch or rice flour, are useful. A solution of subnitrate of bismuth, or bicarbonate of soda, has some value for removing freckles. Powdered nitre, moistened with water and applied to the face night and morning, has also been recommended for removing freckles.

## TABLE OF MEDICINES AND DOSES.

THE following table gives a full list of medicines ordinarily used, with their properties and the doses suitable for adults. The dose for a child is to be determined, excepting in a few dangerous medicines, by this rule : *Add twelve to the child's age in years and divide the sum by the child's age. The quotient shows what proportion of the dose for an adult is to be used.* Thus:

|                                 |        |
|---------------------------------|--------|
| Child's age in years . . . . .  | 6      |
| Add . . . . .                   | 12     |
| Divide by child's age . . . . . | 6)18(3 |

And the dose for a child of six years is found to be one-third of a full dose for most medicines.

MEDICINES AND PROPERTIES.

Doses.

|                                                                     |                                                     |
|---------------------------------------------------------------------|-----------------------------------------------------|
| Aconite leaves, tincture of ; narcotic, sedative and nauseant . . . | 10 to 15 drops 3 times a day.                       |
| Aconite root, tincture of ; narcotic sedative and nauseant . . . .  | 1 to 5 drops 3 times a day.                         |
| Aconite root, fluid extract of : narcotic and sedative . . . . .    | 1 to 3 drops 3 times a day.                         |
| Aconite root, solid extract of ; narcotic and sedative . . . . .    | $\frac{1}{4}$ to $\frac{1}{2}$ grain 3 times a day. |



| MEDICINES AND PROPERTIES.                                                  | Doses.                                                   |
|----------------------------------------------------------------------------|----------------------------------------------------------|
| Aloes socotrine, powdered; purgative . . . . .                             | 10 to 12 grains.                                         |
| Aloes socotrine, pills of; purgative . . . . .                             | 2 to 3 pills at bedtime.                                 |
| Aloes socotrine, tincture of; purgative . . . . .                          | 2 to 4 drams at bedtime.                                 |
| Aloes and myrrh, tincture of; emmenagogue . . . . .                        | 1 to 2 teaspoonfuls 2 or 3 times a day.                  |
| Aloes and myrrh, pills of; emmenagogue . . . . .                           | 3 or 4 pills twice a day.                                |
| Alum, powdered; astringent . . . . .                                       | 3 to 10 grains.                                          |
| Alum, burned; escharotic . . . . .                                         | 10 to 15 grains moistened with water applied externally. |
| Ammonia, carbonate of; stimulant . . . . .                                 | 5 to 6 grains every 2 to 4 hours.                        |
| Ammonia, water of (spirits of hartshorn); stimu. and caustic . . . . .     | 8 to 12 drops diluted with water.                        |
| Ammonia aromatic, spirits of; stimulant . . . . .                          | 10 to 20 drops diluted in water.                         |
| Ammonia liniment (volatile); rubefacient . . . . .                         | applied externally.                                      |
| Ammoniac mixture; expectorant . . . . .                                    | tablespoonful 3 or 4 times a day.                        |
| Angelica root, fluid extract of; stimulant and aromatic . . . . .          | teaspoonful 3 or 4 times a day.                          |
| Angelica root, decoction of; stimulant and aromatic . . . . .              | wine-glassful 2 to 4 times a day.                        |
| Anise-seed, essence of; aromatic and carminative . . . . .                 | 1 to 2 tablespoonfuls.                                   |
| Antimonial wine; emetic . . . . .                                          | 2 to 3 teaspoonfuls.                                     |
| Arrowroot, Bermuda; nutritive and tonic . . . . .                          | as a gruel.                                              |
| Arsenic, Donovan's compound solution of; alterative . . . . .              | 5 to 10 drops 3 times a day.                             |
| Arsenic, Fowler's solution of; alterative and febric . . . . .             | 3 to 5 drops 3 times a day.                              |
| Asafetida, pills of; anti-spasmodic . . . . .                              | 1 to 2 pills.                                            |
| Asafetida, milk of; anti-spasmodic . . . . .                               | 1 to 2 teaspoonfuls.                                     |
| Asafetida, tincture of; anti-spasmodic . . . . .                           | 25 to 40 drops.                                          |
| Balsam of copaiva; diuretic, laxative and stimulant . . . . .              | 20 to 30 drops 3 times a day.                            |
| Balsam of fir; diuretic . . . . .                                          | 10 to 15 drops.                                          |
| Balsam of Peru; stimulant and tonic . . . . .                              | 5 or 10 drops twice a day.                               |
| Balsam of tolu, tincture of; stimulant and tonic . . . . .                 | 20 to 40 drops.                                          |
| Belladonna, fluid extract of; diaphoretic, diuretic and narcotic . . . . . | 3 to 5 drops.                                            |
| Belladonna, tincture of; diaphoretic, diuretic and narcotic . . . . .      | 15 to 25 drops.                                          |
| Belladonna, plaster of; anodyne and diaphoretic . . . . .                  | applied externally.                                      |
| Belladonna, ointment of; anodyne . . . . .                                 | applied externally.                                      |
| Beth root, fluid extract of; astringent and tonic . . . . .                | 25 to 30 drops 2 or 3 times a day.                       |
| Bismuth, subnitrate of; anti-spasmodic, absorbent, sedative . . . . .      | 5 to 10 grains twice a day.                              |
| Bitter sweet, fluid extract of; emetic and narcotic . . . . .              | 30 to 40 drops 3 times a day.                            |
| Black drop; narcotic . . . . .                                             | 10 to 12 drops.                                          |
| Black cohosh, decoction of; narcotic, diaphoretic and diuretic . . . . .   | wine-glassful 3 times a day.                             |
| Black cohosh, tincture of; narcotic, diaphoretic and diuretic . . . . .    | teaspoonful 3 or 4 times a day.                          |
| Black hellebore, fluid extract of; hyd., cath. and emm. . . . .            | 10 to 15 drops 3 or 4 times a day.                       |
| Blackberry root, decoction of; astringent and tonic . . . . .              | wine-glassful 3 or 4 times a day.                        |
| Blackberry root, fluid extract of; astringent and tonic . . . . .          | teaspoonful 3 times a day.                               |
| Blackberry root, syrup of; astringent . . . . .                            | tablespoonful 3 to 6 times a day.                        |
| Blue vitriol; emetic . . . . .                                             | 1 to 3 grains.                                           |
| Blue mass pills; alterative and stologogue . . . . .                       | 1 or 2 pills (5 grains each).                            |
| Boneset, infusion of; stimulant, sudorific and emm. . . . .                | 1 to 2 tablespoonfuls 3 or 4 times a day.                |
| Boneset, fluid extract of; stimulant, sudorific and emm. . . . .           | 30 to 40 drops 3 or 4 times a day.                       |
| Borax, powdered; nephritic and detergent . . . . .                         | 15 to 25 grains.                                         |
| Buchu, infusion of; diaphoretic and diuretic . . . . .                     | tablespoonful 4 or 5 times a day.                        |
| Buchu, fluid extract of; diaphoretic and diuretic . . . . .                | teaspoonful 3 or 4 times a day.                          |
| Buchu, tincture of; diaphoretic and diuretic . . . . .                     | 1 to 2 teaspoonfuls 3 or 4 times a day.                  |
| Buckthorn, fluid extract of; hydragogue cathartic . . . . .                | teaspoonful at bedtime.                                  |
| Burdock, fluid extract of; herpetic anti-scorbutic . . . . .               | tablespoonful.                                           |
| Calomel; alterative . . . . .                                              | $\frac{1}{2}$ to 1 grain every other night.              |
| Camphor, gum; anti-spasmodic and sedative . . . . .                        | 2 to 5 grains.                                           |
| Camphor, spirits of; anti-spasmodic and sedative . . . . .                 | 10 to 25 drops.                                          |
| Camphor, water of; anodyne and sedative . . . . .                          | 2 to 4 teaspoonfuls.                                     |

| MEDICINES AND PROPERTIES.                                                       | Doses.                                          |
|---------------------------------------------------------------------------------|-------------------------------------------------|
| Calamus root, fluid extract of; aromatic, stimulant and stomachic . . . . .     | teaspoonful.                                    |
| Caraway seed, infusion of; aromatic and carminative . . . . .                   | tablespoonful.                                  |
| Cardamon seed, tincture of; aromatic and stimulant . . . . .                    | teaspoonful.                                    |
| Catechu; powdered; astringent . . . . .                                         | 15 to 30 grains.                                |
| Catechu, tincture of; astringent . . . . .                                      | 1 teaspoonful.                                  |
| Catnip, decoction of; diaphoretic, stomachic and corrective . . . . .           | tablespoonful.                                  |
| Cayenne pepper (powdered); stimulant . . . . .                                  | 3 or 6 grains.                                  |
| Cayenne pepper, tincture of; stimulant . . . . .                                | 10 to 15 drops.                                 |
| Castor oil; purgative . . . . .                                                 | 1 to 2 tablespoonfuls.                          |
| Chamomile flowers, cold infusion of; tonic and stomachic . . . . .              | 1 to 2 tablespoonfuls 3 times a day.            |
| Chalk, prepared; antacid and astringent . . . . .                               | 10 to 30 grains in mucilage.                    |
| Chalk mixture; antacid and astringent . . . . .                                 | 2 or 3 teaspoonfuls.                            |
| Chloroform; narcotic and sedative . . . . .                                     | 30 to 60 drops in mucilage.                     |
| Chloroform, liniment of; anæsthetic and anodyne . . . . .                       | applied externally.                             |
| Cinnamon, powdered; astringent and stomachic . . . . .                          | 5 to 15 grains.                                 |
| Cinnamon, oil of; astringent and stomachic . . . . .                            | 2 to 4 drops.                                   |
| Cinnamon, essence of; astringent and stomachic . . . . .                        | 20 to 25 drops.                                 |
| Cloves (powdered); aromatic, carminative and stimulant . . . . .                | 10 to 15 grains.                                |
| Cloves, oil of; stimulant, aromatic and carminative . . . . .                   | 2 to 6 drops.                                   |
| Comfrey root, decoction of; diuretic, stimulant and alter. . . . .              | tablespoonful 3 or 4 times a day.               |
| Colombo root, decoction of; tonic . . . . .                                     | tablespoonful 3 times a day.                    |
| Colchicum root, wine of; narcotic, diuretic and sedative . . . . .              | 10 to 30 drops 3 times a day.                   |
| Colchicum seed, tincture of; narcotic, diuretic and sedative . . . . .          | 30 to 50 drops 3 times a day.                   |
| Corrosive sublimate; anti-syphilitic . . . . .                                  | 1-60 to $\frac{1}{3}$ grain 2 or 3 times a day. |
| Cotton root, fluid extract of; emmenagogue, parturient and abortive . . . . .   | 20 to 30 drops.                                 |
| Cream tartar; aperient and refrigerant . . . . .                                | teaspoonful in water.                           |
| Cubebs (powdered); stimulant and diuretic . . . . .                             | 20 to 30 grains.                                |
| Cubebs, fluid extract of; stimulant and diuretic . . . . .                      | 20 to 40 drops.                                 |
| Cubebs, tincture of; stimulant and diuretic . . . . .                           | 1 to 2 teaspoonfuls.                            |
| Cubebs, oil of; stimulant and diuretic . . . . .                                | 10 to 12 drops on sugar.                        |
| Dandelion, fluid extract of; alterative, aperient, tonic and diuretic . . . . . | 1 to 2 teaspoonfuls.                            |
| Dogwood bark, decoction of; tonic, astringent and stimulant . . . . .           | wine-glassful 2 or 3 times a day.               |
| Dover's powder; diaphoretic . . . . .                                           | 10 to 15 grains at bedtime.                     |
| Elder flower, decoction of; alterative, diaphoretic and diuretic . . . . .      | 1 to 2 tablespoonfuls.                          |
| Elecampane, decoction of; diaphoretic and expectorant . . . . .                 | tablespoonful.                                  |
| Elecampane, syrup of; diaphoretic and expectorant . . . . .                     | tablespoonful.                                  |
| Elm bark, infusion of; demulcent and diuretic . . . . .                         | wine-glassful.                                  |
| Epsom salts; cathartic . . . . .                                                | 2 or 3 teaspoonfuls before breakfast.           |
| Ergot, powdered (fresh); astringent . . . . .                                   | 15 to 30 grains.                                |
| Ergot, fluid extract of; astringent . . . . .                                   | 15 to 60 drops.                                 |
| Ergot, tincture of; astringent . . . . .                                        | 1 teaspoonful.                                  |
| Ergot, wine of; astringent . . . . .                                            | 1 teaspoonful.                                  |
| Fennel seed, infusion of; aromatic and carminative . . . . .                    | tablespoonful.                                  |
| Fennel seed, oil of; aromatic and carminative . . . . .                         | 3 to 6 drops.                                   |
| Fever root, decoction of; diuretic, cathartic and emetic . . . . .              | tablespoonful.                                  |
| Flaxseed, infusion of; demulcent . . . . .                                      | wine-glassful every 3 or 4 hours.               |
| Flaxseed, poultice of; astringent . . . . .                                     | excellent for drawing.                          |
| Flaxseed, oil, and lime water . . . . .                                         | applied to scalds and burns.                    |
| Foxglove, powdered; diuretic, narcotic and sedative . . . . .                   | 1 grain 2 or 3 times a day.                     |
| Foxglove, tincture of; diuretic, narcotic and sedative . . . . .                | 10 to 15 drops 2 or 3 times a day.              |
| Garlic, syrup of; expectorant . . . . .                                         | 1 to 2 teaspoonfuls.                            |
| Gentian, tincture of; tonic . . . . .                                           | 1 teaspoonful.                                  |
| Ginger, powdered; stimulant and carminative . . . . .                           | 20 to 30 grains.                                |
| Ginger, tincture of; stimulant and carminative . . . . .                        | 1 to 2 teaspoonfuls.                            |

| MEDICINES AND PROPERTIES.                                                                    | DOSES.                                                                           |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Glauber salts; aperient and cathartic . . . . .                                              | 1 to 2 teaspoonfuls before breakfast.                                            |
| Gelsemium, fluid extract of; narcotic, sedative, diaphoretic and febrifuge . . . . .         | 5 to 10 drops.                                                                   |
| Gelsemium, tincture of; narcotic, sedative, diaphoretic and febrifuge . . . . .              | 10 to 25 drops.                                                                  |
| Gum arabic, mucilage of; demulcent . . . . .                                                 | tablespoonful every 3 or 4 hours.                                                |
| Guaiacum, tincture of; diaphoretic and diuretic . . . . .                                    | teaspoonful 2 or 3 times a day.                                                  |
| Henbane, tincture of; narcotic and anodyne . . . . .                                         | $\frac{1}{2}$ teaspoonful.                                                       |
| Henbane, fluid extract of; narcotic and anodyne . . . . .                                    | 15 to 25 drops.                                                                  |
| Hiera pica (powdered); purgative and stomachic . . . . .                                     | 10 to 20 grains.                                                                 |
| Hoarhound, decoction of; sudorific, pectoral, aperient and tonic . . . . .                   | tablespoonful.                                                                   |
| Hoarhound, syrup of; sudorific and pectoral . . . . .                                        | tablespoonful.                                                                   |
| Hydrastin (active principal of yellow root), astringent, tonic, stomachic, anti-bil. . . . . | 1 to 2 grains.                                                                   |
| Iodine, tincture of; alterative and discutient . . . . .                                     | applied to scrofulous tumors.                                                    |
| Iodine, ointment of; discutient . . . . .                                                    | applied to scrofulous tumors.                                                    |
| Iron, carbonate (rust) of; tonic . . . . .                                                   | 5 to 10 grains.                                                                  |
| Iron, syrup of iodide of; alterative, diuretic and tonic . . . . .                           | 5 to 10 drops twice a day.                                                       |
| Iron tincture, muriate of; tonic . . . . .                                                   | 10 to 30 drops.                                                                  |
| Irish moss, infusion of; nutritive, demulcent and expectorant . . . . .                      | tablespoonful.                                                                   |
| Ipecac, powdered; emetic and diaphoretic . . . . .                                           | 20 grains.                                                                       |
| Ipecac, fluid extract of; emetic and diaphoretic . . . . .                                   | 20 to 25 drops.                                                                  |
| Ipecac, wine of; emetic and diaphoretic . . . . .                                            | 1 to 2 teaspoonfuls.                                                             |
| Ipecac, syrup of; emetic and diaphoretic . . . . .                                           | teaspoonful repeated.                                                            |
| Jalap, powdered; cathartic . . . . .                                                         | 15 to 30 grains.                                                                 |
| Juniper berries, infusion of; diuretic . . . . .                                             | wine-glassful 3 or 4 times a day.                                                |
| Lactucarium; anodyne . . . . .                                                               | 5 to 10 grains.                                                                  |
| Ladies-slipper root, decoction of; nervine . . . . .                                         | tablespoonful.                                                                   |
| Laudanum; narcotic . . . . .                                                                 | 20 to 25 drops.                                                                  |
| Lead, acetate (sugar) of; astringent and sedative . . . . .                                  | 1 to 3 grains every 3 or 4 hours.                                                |
| Lead, Goulard's extract of; anodyne and sedative . . . . .                                   | 1 ounce diluted with 1 pint of water; applied externally to reduce inflammation. |
| Licorice root, decoction of; demulcent and expectorant . . . . .                             | wine-glassful.                                                                   |
| Life everlasting, decoction of; astringent, diaphoretic and stomachic . . . . .              | 1 to 2 tablespoonfuls.                                                           |
| Liverwort, decoction of; astringent, demulcent and pectoral . . . . .                        | 1 to 2 tablespoonfuls.                                                           |
| Lobelia herb, infusion of; emetic and diaphoretic . . . . .                                  | 2 teaspoonfuls.                                                                  |
| Lobelia herb, powdered; emetic and diaphoretic . . . . .                                     | 10 to 15 grains.                                                                 |
| Lobelia seed, tincture of; diaphoretic, emetic and expectorant . . . . .                     | 20 to 40 drops.                                                                  |
| Magnesia, carbonate; antacid and laxative . . . . .                                          | 15 to 60 grains.                                                                 |
| Magnesia, calcined; antacid and laxative . . . . .                                           | 15 to 60 grains.                                                                 |
| May-apple root, powdered; cathartic, hydragogue and emetic . . . . .                         | 15 to 20 grains at bedtime.                                                      |
| May-apple root, fluid extract of; hydragogue, cathartic and emetic . . . . .                 | 15 to 30 drops at bedtime.                                                       |
| Manna; laxative . . . . .                                                                    | 1 to 2 drachms before breakfast.                                                 |
| Manna, syrup of; laxative . . . . .                                                          | 1 to 2 tablespoonfuls before breakfast.                                          |
| Mercury with chalk; alterative . . . . .                                                     | 10 grains.                                                                       |
| Mercury, red precipitate ointment; stimulant . . . . .                                       | applied externally.                                                              |
| Mercurial ointment (blue); resolvent . . . . .                                               | applied externally.                                                              |
| Morphine, sulphate of; anodyne and soporific . . . . .                                       | $\frac{1}{8}$ to $\frac{1}{4}$ grain.                                            |
| Morphine, solution of; anodyne and soporific . . . . .                                       | 1 teaspoonful.                                                                   |
| Morphine, syrup of; anodyne and soporific . . . . .                                          | 1 to 2 teaspoonfuls.                                                             |
| Motherwort, decoction of; emmenagogue and nervine . . . . .                                  | 1 to 2 tablespoonfuls.                                                           |
| Mustard seed (black), ground; diuretic, emetic and stimulant . . . . .                       | $\frac{1}{2}$ to 1 teaspoonful.                                                  |
| Mustard seed (white) ground; diuretic, emetic and stimulant . . . . .                        | wine-glassful.                                                                   |
| Nitrate of silver (crystals); astringent and anti-spasmodic . . . . .                        | $\frac{1}{4}$ to $\frac{1}{2}$ grain 2 or 3 times a day.                         |
| Nitrate of silver, lunar caustic (sticks); escharotic . . . . .                              | applied externally.                                                              |
| Nutgalls, tincture of; astringent . . . . .                                                  | 1 to 2 teaspoonfuls.                                                             |
| Nutgalls, ointment of; astringent . . . . .                                                  | 1 to 2 teaspoonfuls.                                                             |



## MEDICINES AND PROPERTIES.

## DOSES.

|                                                                                     |                                                 |
|-------------------------------------------------------------------------------------|-------------------------------------------------|
| Nux vomica, tincture of; diur., excre., stimulant and tonic . . . . .               | 15 drops 3 times a day.                         |
| Nux vomica, fluid extract of; diur., excre., stim. and tonic . . . . .              | 1 to 5 drops 2 or 3 times a day.                |
| Opium, powdered; narcotic and stimulant . . . . .                                   | 1 grain at bedtime.                             |
| Opium, tincture of. (See Laudanum.)                                                 |                                                 |
| Opium, camphorated tincture of. (See Paregoric.)                                    |                                                 |
| Paregoric; anodyne. . . . .                                                         | 1 to 2 teaspoonfuls.                            |
| Penmyroyal, infusion of; diaphoretic, emmenagogue and stimulant. . . . .            | wine-glassful every hour.                       |
| Peppermint, infusion of; stimulant and carminative . . . . .                        | wine-glassful 2 or 3 times a day.               |
| Peruvian bark, powdered; febrifuge and tonic . . . . .                              | 1 drachm 2 or 3 times a day.                    |
| Peruvian bark, decoction of; febrifuge and tonic . . . . .                          | wine-glassful 3 or 4 times a day.               |
| Peruvian bark, fluid extract of; tonic and febrifuge. . . . .                       | 30 to 60 drops 3 times a day.                   |
| Peperine (active principle of black pepper); tonic and stimulant. . . . .           | 1 to 3 grains.                                  |
| Pink root, infusion of; anthelmintic . . . . .                                      | tablespoonful before meals.                     |
| Pink root, fluid extract of; anthelmintic . . . . .                                 | $\frac{1}{2}$ to 1 teaspoonful before meals.    |
| Pink root and senna, fluid extract of; anthelmintic and purgative . . . . .         | teaspoonful before meals.                       |
| Podophillin (active principle of mandrake); diuretic and purgative. . . . .         | 1 to 3 grains at bedtime.                       |
| Potash, chlorate . . . . .                                                          | 10 to 15 grains dissolved in water.             |
| Potash, citrate; refrigerant and diaphoretic . . . . .                              | 20 to 25 grains.                                |
| Potash, nitrate (saltpetre); refrigerant and diaphoretic . . . . .                  | 6 to 12 grains.                                 |
| Potassium, bromide of; anti-scorbutic . . . . .                                     | 5 to 60 grains.                                 |
| Potassium, iodide of; alterative and anti-syphilitic . . . . .                      | 5 to 15 grains 3 times a day.                   |
| Rochelle salts; aperient . . . . .                                                  | 2 or 3 drams before breakfast.                  |
| Rhatany root, decoction of; astringent and tonic. . . . .                           | tablespoonful.                                  |
| Rhatany root, tincture of; astringent and tonic . . . . .                           | teaspoonful.                                    |
| Rhubarb, powdered; astringent and cathartic . . . . .                               | 20 to 30 grains.                                |
| Rhubarb, tincture of; astringent and cathartic . . . . .                            | 1 to 2 teaspoonfuls.                            |
| Rhubarb, fluid extract of; cathartic and astringent . . . . .                       | 25 to 40 drops.                                 |
| Rhubarb, syrup of; cathartic and astringent . . . . .                               | 2 or 3 teaspoonfuls.                            |
| Rue herb, decoction of; tonic, anthelmintic and emmenagogue . . . . .               | tablespoonful.                                  |
| Saffron, American, infusion of; diaphoretic. . . . .                                | 2 to 3 teaspoonfuls.                            |
| Saffron, Spanish, infusion of; diaphoretic . . . . .                                | 1 to 2 teaspoonfuls.                            |
| Sage, infusion of; sudorific and stomachic. . . . .                                 | wine-glassful.                                  |
| Sassafras pith, infusion of; demulcent and anodyne. . . . .                         | 1 or 2 teaspoonfuls, also applied to sore eyes. |
| Sassafras bark, infusion of; diaphoretic and stimulant . . . . .                    | wine-glassful every 2 or 3 hours.               |
| Sarsaparilla, decoction of; alterative and deobstruent . . . . .                    | teacupful 3 times a day.                        |
| Sarsaparilla, fluid extract of; alterative and deobstruent. . . . .                 | teaspoonful 3 times a day.                      |
| Sarsaparilla, compound syrup of; alterative and deobstruent. . . . .                | tablespoonful 4 to 6 times a day.               |
| Scammony; cathartic. . . . .                                                        | 10 to 15 grains at bedtime.                     |
| Senega, snake root, fluid extract of; expectorant, stimulant and diuretic . . . . . | tablespoonful.                                  |
| Senna, decoction of; cathartic . . . . .                                            | 1 to 2 tablespoonfuls.                          |
| Senna, fluid extract of; cathartic . . . . .                                        | 1 teaspoonful.                                  |
| Stramonium leaves, tincture of; narcotic, sedative, anti-spas. . . . .              | 20 to 30 drops 2 or 3 times a day.              |
| Stramonium leaves, ointment of; sedative . . . . .                                  | applied externally.                             |
| Soda, bicarbonate; antacid. . . . .                                                 | 15 to 30 grains.                                |
| Seidlitz powders; aperient . . . . .                                                | 1 powder before breakfast.                      |
| Sweet spirits of nitre; diaphoretic, diuretic and febrifuge . . . . .               | 30 to 60 drops.                                 |
| Tansy (double), decoction of; sudorific, emmenagogue and anthelmintic . . . . .     | 1 to 2 tablespoonfuls.                          |
| Thyme, infusion of; aromatic and stomachic . . . . .                                | wine-glassful.                                  |
| Uva ursi, leaves decoction of; diuretic and tonic . . . . .                         | wine-glassful 3 or 4 times a day.               |
| Uva ursi, fluid extract of; diuretic and tonic. . . . .                             | teaspoonful 3 or 4 times a day.                 |
| Waterpepper herb, tincture of; stimulant, diuretic, and emmenagogue . . . . .       | teaspoonful.                                    |
| Wild-cherry bark, cold infusion of; tonic, astringent and sedative . . . . .        | tablespoonful 3 times a day.                    |
| Wild-cherry bark, syrup of; sedative . . . . .                                      | tablespoonful 3 times a day.                    |

# INSTRUCTIVE TABLES UPON HYGIENIC SUBJECTS.

EXPECTATION OF LIFE AT VARIOUS AGES.

| Age.     | Male. | Fem.  | Age.     | Male. | Fem.  | Age.     | Male. | Fem.  | Age.      | Male. | Fem. |
|----------|-------|-------|----------|-------|-------|----------|-------|-------|-----------|-------|------|
| 0 years  | 39.91 | 41.85 | 25 years | 36.12 | 37.04 | 50 years | 19.54 | 20.75 | 75 years  | 6.49  | 6.93 |
| 1 years  | 46.65 | 47.31 | 26 years | 35.44 | 36.39 | 51 years | 18.90 | 20.09 | 76 years  | 6.15  | 6.56 |
| 2 years  | 48.83 | 49.40 | 27 years | 34.77 | 35.75 | 52 years | 18.28 | 19.42 | 77 years  | 5.82  | 6.21 |
| 3 years  | 49.61 | 50.20 | 28 years | 34.10 | 35.10 | 53 years | 17.67 | 18.75 | 78 years  | 5.51  | 5.88 |
| 4 years  | 49.81 | 50.43 | 29 years | 33.43 | 34.46 | 54 years | 17.06 | 18.08 | 79 years  | 5.21  | 5.56 |
| 5 years  | 49.71 | 50.33 | 30 years | 32.76 | 33.81 | 55 years | 16.45 | 17.43 | 80 years  | 4.93  | 5.26 |
| 6 years  | 49.39 | 50.00 | 31 years | 32.09 | 33.17 | 56 years | 15.86 | 16.79 | 81 years  | 4.66  | 4.98 |
| 7 years  | 48.92 | 49.53 | 32 years | 31.42 | 32.53 | 57 years | 15.26 | 16.17 | 82 years  | 4.41  | 4.71 |
| 8 years  | 48.37 | 48.98 | 33 years | 30.74 | 31.88 | 58 years | 14.68 | 15.55 | 83 years  | 4.17  | 4.45 |
| 9 years  | 47.74 | 48.35 | 34 years | 30.07 | 31.23 | 59 years | 14.10 | 14.94 | 84 years  | 3.95  | 4.21 |
| 10 years | 47.05 | 47.67 | 35 years | 29.40 | 30.59 | 60 years | 13.53 | 14.34 | 85 years  | 3.73  | 3.98 |
| 11 years | 46.31 | 46.95 | 36 years | 28.73 | 29.94 | 61 years | 12.96 | 13.75 | 86 years  | 3.53  | 3.76 |
| 12 years | 45.54 | 46.20 | 37 years | 28.06 | 29.29 | 62 years | 12.41 | 13.17 | 87 years  | 3.34  | 3.56 |
| 13 years | 44.76 | 45.44 | 38 years | 27.39 | 28.64 | 63 years | 11.87 | 12.60 | 88 years  | 3.16  | 3.36 |
| 14 years | 43.97 | 44.68 | 39 years | 26.72 | 27.99 | 64 years | 11.34 | 12.05 | 89 years  | 3.00  | 3.18 |
| 15 years | 43.18 | 43.90 | 40 years | 26.06 | 27.34 | 65 years | 10.82 | 11.51 | 90 years  | 2.84  | 3.01 |
| 16 years | 42.40 | 43.14 | 41 years | 25.39 | 26.69 | 66 years | 10.32 | 10.98 | 91 years  | 2.69  | 2.85 |
| 17 years | 41.64 | 42.40 | 42 years | 24.73 | 26.03 | 67 years | 9.83  | 10.47 | 92 years  | 2.55  | 2.70 |
| 18 years | 40.90 | 41.67 | 43 years | 24.07 | 25.38 | 68 years | 9.36  | 9.97  | 93 years  | 2.41  | 2.55 |
| 19 years | 40.17 | 40.97 | 44 years | 23.41 | 24.72 | 69 years | 8.90  | 9.48  | 94 years  | 2.29  | 2.42 |
| 20 years | 39.48 | 40.29 | 45 years | 22.76 | 24.06 | 70 years | 8.45  | 9.02  | 95 years  | 2.17  | 2.29 |
| 21 years | 38.80 | 39.63 | 46 years | 22.11 | 23.40 | 71 years | 8.03  | 8.57  | 96 years  | 2.06  | 2.17 |
| 22 years | 38.13 | 38.98 | 47 years | 21.46 | 22.74 | 72 years | 7.62  | 8.13  | 97 years  | 1.95  | 2.06 |
| 23 years | 37.46 | 38.33 | 48 years | 20.82 | 22.08 | 73 years | 7.22  | 7.71  | 98 years  | 1.85  | 1.96 |
| 24 years | 36.79 | 37.68 | 49 years | 20.17 | 21.42 | 74 years | 6.85  | 7.31  | 99 years  | 1.76  | 1.86 |
|          |       |       |          |       |       |          |       |       | 100 years | 1.68  | 1.76 |

TABLE SHOWING THE DEATH-RATE PER 1,000 OF EACH SEX IN EACH OF THE THREE CONDITIONS OF LIFE.

| AGES.   | MALES.     |          |           | FEMALES.   |          |         |
|---------|------------|----------|-----------|------------|----------|---------|
|         | Unmarried. | Married. | Widowers. | Unmarried. | Married. | Widows. |
| 20-25.. | 12.88      | 8.92     | 49.60     | 8.32       | 9.92     | 12.31   |
| 25-30.. | 10.17      | 6.24     | 21.84     | 9.02       | 8.98     | 23.62   |
| 30-35.. | 11.51      | 6.82     | 19.17     | 9.87       | 9.36     | 16.90   |
| 35-40.. | 13.15      | 7.52     | 17.50     | 10.87      | 9.29     | 15.03   |
| 40-45.. | 16.62      | 9.55     | 18.89     | 13.28      | 10.14    | 12.73   |
| 45-50.. | 19.60      | 11.47    | 22.20     | 15.71      | 10.69    | 13.30   |
| 50-55.. | 25.80      | 15.61    | 26.80     | 20.97      | 14.11    | 15.20   |
| 55-60.. | 32.10      | 21.50    | 34.17     | 26.90      | 19.29    | 24.47   |
| 60-65.. | 45.92      | 32.60    | 47.50     | 40.52      | 30.75    | 37.07   |
| 65-70.. | 58.50      | 44.80    | 62.97     | 58.30      | 45.30    | 53.50   |

## BIRTH, MARRIAGE, AND DEATH STATISTICS.

The following interesting table gives a comparative view of the fertility of marriages, the legitimacy and illegitimacy of births, and the mortality in city and country in the various European States:

| COUNTRIES.    | CHILDREN TO ONE MARRIAGE |        | INFANT MORTALITY. |          | ADULT MORTALITY. |          | FERTILITY OF MARRIAGE. |        | ILLEGITIMATE TO LEGITIMATE BIRTHS |          |
|---------------|--------------------------|--------|-------------------|----------|------------------|----------|------------------------|--------|-----------------------------------|----------|
|               | City.                    | Coun'y | City.             | Country. | City.            | Country. | City.                  | Coun'y | City.                             | Country. |
| France. . .   | 3.16                     | 3.28   | *35.69            | *28.56   | 1:31.51          | 1:42.21  | 2.03                   | 2.34   | *15.13                            | *4.24    |
| Netherlands.  | 3.91                     | 4.32   | 36.25             | 28.90    | 1:35.55          | 1:43.03  | 2.49                   | 3.07   | 7.7                               | 2.84     |
| Belgium. . .  | 3.80                     | 4.17   |                   |          | 1:34.35          | 1:44.31  |                        |        | 14.59                             | 5.88     |
| Sweden. . .   | 2.99                     | 4.19   | 38.86             | 24.50    | 1:28.95          | 1:46.86  | 1.83                   | 3.16   | 27.44                             | 7.50     |
| Denmark. . .  | 3.04                     | 3.34   | 29.66             | 22.68    | 1:37.41          | 1:49.77  | 2.14                   | 2.58   | 16.45                             | 10.06    |
| Schleswig. .  | 3.50                     | 3.69   | 27.42             | 23.42    | 1:35.17          | 1:48.49  | 2.54                   | 2.83   | 8.38                              | 6.37     |
| Holstein. . . | 3.37                     | 3.88   | 29.92             | 25.29    | 1:38.73          | 1:44.15  | 2.36                   | 2.90   | 15.50                             | 8.74     |
| Saxony. . .   | 4.60                     | 4.13   | 39.88             | 36.22    | 1:31.10          | 1:34.70  | 2.77                   | 2.64   | 15.39                             | 14.64    |
| Hanover. . .  | 2.93                     | 3.65   | 28.70             | 26.47    | 1:38.52          | 1:41.17  | 2.08                   | 2.68   | 17.42                             | 9.06     |
| Prussia. . .  | 4.00                     | 4.44   | 36.02             | 29.47    | 1:27.97          | 1:34.46  | 2.56                   | 3.13   | 9.80                              | 6.60     |

\* Per cent.

## AVERAGE LENGTH OF LIFE IN VARIOUS OCCUPATIONS.

The Report of Registration of the State of Massachusetts shows that the average length of life of the various trades and professions has been in the last thirty years as follows:

| Occupations.                       | Years. | Occupations.                   | Years. |
|------------------------------------|--------|--------------------------------|--------|
| Farmers. . . . .                   | 65.19  | Artists. . . . .               | 44.56  |
| Millers. . . . .                   | 57.43  | Shoemakers. . . . .            | 44.45  |
| Sawyers. . . . .                   | 56.67  | Brushmakers. . . . .           | 43.40  |
| Physicians. . . . .                | 55.08  | Furnace Men. . . . .           | 43.05  |
| Hatters. . . . .                   | 54.55  | Founders. . . . .              | 42.73  |
| Clock and Watchmakers. . . . .     | 54.43  | Shoecutters. . . . .           | 42.62  |
| Carpenters and Joiners. . . . .    | 53.31  | Pianofortemakers. . . . .      | 42.50  |
| Blacksmiths. . . . .               | 53.31  | Glasscutters. . . . .          | 42.39  |
| Sailmakers. . . . .                | 52.84  | Civil Engineers. . . . .       | 42.34  |
| Woodturners. . . . .               | 52.55  | Chairmakers. . . . .           | 41.59  |
| Combmakers. . . . .                | 51.38  | Engineers. . . . .             | 41.57  |
| Masons. . . . .                    | 50.48  | Musicians. . . . .             | 41.19  |
| Butchers. . . . .                  | 50.29  | Tinsmiths. . . . .             | 40.96  |
| Tanners. . . . .                   | 50.05  | Expressmen. . . . .            | 40.94  |
| Cabinetmakers. . . . .             | 48.65  | Nailmakers. . . . .            | 40.80  |
| Gunsmiths. . . . .                 | 48.57  | Machinists. . . . .            | 40.80  |
| Carriagemakers. . . . .            | 48.38  | Jewelers. . . . .              | 40.29  |
| Harnessmakers. . . . .             | 48.36  | Servants (women). . . . .      | 40.19  |
| Brickmakers. . . . .               | 47.99  | Teamsters. . . . .             | 40.13  |
| Woolsorters. . . . .               | 47.55  | Bookbinders. . . . .           | 39.94  |
| Leatherdressers. . . . .           | 47.41  | Upholsters. . . . .            | 39.78  |
| Laborers. . . . .                  | 47.39  | Barbers. . . . .               | 39.77  |
| Musical Instrument Makers. . . . . | 47.32  | Pail and Tubmakers. . . . .    | 39.50  |
| Tailors. . . . .                   | 47.19  | Cutlers. . . . .               | 39.23  |
| Architects. . . . .                | 47.15  | Operatives. . . . .            | 38.92  |
| Bakers. . . . .                    | 46.76  | Printers. . . . .              | 38.57  |
| Dressmakers (women). . . . .       | 46.49  | Cigarmakers. . . . .           | 38.31  |
| Seamen. . . . .                    | 46.33  | Engineers and Firemen. . . . . | 38.21  |
| Stonecutters. . . . .              | 46.30  | Drivers. . . . .               | 38.16  |
| Coppersmiths. . . . .              | 46.07  | Milliners. . . . .             | 37.30  |
| Silver and Goldsmiths. . . . .     | 45.46  | Glassblowers. . . . .          | 37.81  |
| Dyers. . . . .                     | 45.35  | Plumbers. . . . .              | 35.43  |
| Mechanics. . . . .                 | 45.13  | Carvers. . . . .               | 33.84  |
| Painters. . . . .                  | 45.05  | Operatives (women). . . . .    | 27.98  |
| Weavers. . . . .                   | 44.65  |                                |        |



## AVERAGE WEIGHT AND STATURE OF MAN.

| MALES.             |       |         | FEMALES.           |       |         |
|--------------------|-------|---------|--------------------|-------|---------|
| Age.               | Feet. | Pounds. | Age.               | Feet. | Pounds. |
| 0 years . . . . .  | 1.64  | 7.06    | 0 years . . . . .  | 1.62  | 6.42    |
| 2 years . . . . .  | 2.60  | 25.01   | 2 years . . . . .  | 2.56  | 23.53   |
| 4 years . . . . .  | 3.04  | 31.38   | 4 years . . . . .  | 3.00  | 28.67   |
| 6 years . . . . .  | 3.44  | 38.80   | 6 years . . . . .  | 3.38  | 35.29   |
| 9 years . . . . .  | 4.00  | 49.95   | 9 years . . . . .  | 3.92  | 47.10   |
| 11 years . . . . . | 4.36  | 49.77   | 11 years . . . . . | 4.26  | 56.57   |
| 13 years . . . . . | 4.72  | 75.81   | 13 years . . . . . | 4.60  | 72.65   |
| 15 years . . . . . | 5.07  | 96.40   | 15 years . . . . . | 4.92  | 89.04   |
| 17 years . . . . . | 5.36  | 116.56  | 17 years . . . . . | 5.10  | 104.34  |
| 18 years . . . . . | 5.44  | 127.59  | 18 years . . . . . | 5.13  | 112.55  |
| 20 years . . . . . | 5.49  | 132.46  | 20 years . . . . . | 5.16  | 115.30  |
| 30 years . . . . . | 5.52  | 140.38  | 30 years . . . . . | 5.18  | 119.82  |
| 40 years . . . . . | 5.52  | 140.42  | 40 years . . . . . | 5.18  | 121.81  |
| 50 years . . . . . | 5.49  | 139.96  | 50 years . . . . . | 5.04  | 123.86  |
| 60 years . . . . . | 5.38  | 136.07  | 60 years . . . . . | 4.97  | 119.76  |
| 70 years . . . . . | 5.32  | 131.27  | 70 years . . . . . | 4.97  | 113.60  |
| 80 years . . . . . | 5.29  | 127.54  | 80 years . . . . . | 4.94  | 108.80  |
| 90 years . . . . . | 5.29  | 127.54  | 90 years . . . . . | 4.94  | 108.81  |

## COMPOSITION OF THE HUMAN BODY.

| ELEMENTS.                                                                                                                                               | Pounds. | Ounces. | Grains. |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|---------|
| 1. Water, which is found in every part of the body, and amounts to . . . . .                                                                            | 109     | 0       | 0       |
| 2. Fibrine, and like substances, found in the blood, and forming the chief solid materials of the flesh . . . . .                                       | 15      | 10      | 0       |
| 3. Phosphate of lime, chiefly in bones and teeth, but in all liquids and tissues . . . . .                                                              | 8       | 12      | 0       |
| 4. Fat, a mixture of three chemical compounds, and distributed all through the body . . . . .                                                           | 4       | 8       | 0       |
| 5. Osseine, the organic framework of bones; boiled, gives gelatine. Weight . . . . .                                                                    | 4       | 7       | 350     |
| 6. Keratine, a nitrogenous substance, forming the greater part of hair, nails, and skin. Weighs . . . . .                                               | 4       | 2       | 0       |
| 7. Cartilage resembles the osseine or bone, and is a nitrogenous substance, the chief constituent of cartilage, weighing . . . . .                      | 1       | 8       | 0       |
| 8. Hemoglobine gives the red color to blood, and is a nitrogenous substance containing iron, and weighing . . . . .                                     | 1       | 8       | 0       |
| 9. Albumen is a soluble nitrogenous substance, found in the blood, chyle, lymph, and muscle, and weighs . . . . .                                       | 1       | 1       | 0       |
| 10. Carbonate of lime is found in the bones chiefly, and weighs . . . . .                                                                               | 1       | 1       | 0       |
| 11. Hephalin is found in nerves and brain, with cerebrine and other compounds . . . . .                                                                 | 0       | 13      | 0       |
| 12. Fluoride of calcium is found in teeth and bones, and weighs . . . . .                                                                               | 0       | 7       | 175     |
| 13. Phosphate of magnesia is also in teeth and bones, and weighs . . . . .                                                                              | 0       | 7       | 0       |
| 14. Chloride of sodium, or common salt, is found in all parts of the body, and weighs . . . . .                                                         | 0       | 7       | 0       |
| 15. Cholesterin, glycogen, and inosite are compounds containing hydrogen, oxygen, and carbon, found in muscle, liver, and brain, and weighing . . . . . | 0       | 3       | 0       |
| 16. Sulphate, phosphate, and salts of sodium, found in all tissues and liquids . . . . .                                                                | 0       | 2       | 107     |
| 17. Sulphate, phosphates, and chloride of potassium, are also in all tissues and liquids . . . . .                                                      | 0       | 0       | 300     |
| 18. Silica, found in hair, skin, and bone . . . . .                                                                                                     | 0       | 0       | 30      |
|                                                                                                                                                         | 154     | 0       | 0       |

# GLOSSARY.

N. B.—For Terms not given here consult the Index to this Volume and the larger Dictionaries.

- Abdomen.* The belly.  
*Abnormal.* Unnatural.  
*Abortion.* The expulsion of a child from the womb before it is fully developed.  
*Abscess.* A pus cavity.  
*Absorbent.* A medicine which takes up acidity from the bowels and stomach.  
*Acidity.* Sourness.  
*Acrid.* Bitter, pungent.  
*Acute.* Severe and sudden (of a disease).  
*Adhesive.* Sticking, uniting.  
*Adjuvant.* A medicine added to a prescription to assist the action of the other medicines.  
*Adult.* A person of full growth.  
*Affection.* Disease, sickness.  
*Affusion.* The action of pouring a liquid upon any body.  
*Aliment.* Food, nourishment.  
*Alimentary.* Capable of affording nourishment.  
*Alkali.* A substance, like soda, which can destroy acidity.  
*Alluvial.* Belonging to soil formed by deposits of mud, etc.  
*Alterative.* A medicine which effects a beneficial change in the system.  
*Alveole.* A tooth-socket.  
*Alvine.* Relating to the intestines.  
*Amputation.* The operation of cutting off a limb or part of a limb.  
*Amylaceous.* Containing starch.  
*Anæmia.* Privation of blood.  
*Anæsthesia.* Privation of sensation.  
*Anæsthetic.* A medicine that deprives of sensation.  
*Analysis.* The resolving of anything into its component parts.  
*Anastomosis.* Communication between two vessels.  
*Anodyne.* A medicine which relieves pain.  
*Antacid.* A medicine which counteracts acidity.  
*Antaphrodisiac.* A medicine which cools the animal passions.  
*Anthelmintic.* A medicine or other remedy for worms.  
*Antibilious.* That which counteracts biliousness.  
*Antidote.* A remedy which counteracts the effects of poisons.  
*Antimorbific.* That which opposes disease.  
*Antiperiodic.* A remedy for periodical disease.  
*Antiscorbutic.* A remedy for scurvy.  
*Antiseptic.* That which resists putrefaction.  
*Antispasmodic.* A remedy for spasms.  
*Antisyphilitic.* A remedy for syphilis.  
*Aperient.* A medicine which opens the bowels gently.  
*Aphthous.* Pertaining to sore mouth.  
*Apnœa.* Absence of breathing.  
*Apparatus.* A set of implements for some special use.  
*Areola.* The colored circle surrounding the nipple or surrounding sores.  
*Aroma.* Intense perfume, odor.  
*Arthritic.* Relating to inflammation of the joints.  
*Articulated.* Jointed.  
*Asphyxia.* Suspended animation.  
*Aspirate.* To breathe roughly.  
*Assimilation.* The act of taking proper nutriment from food into the system.  
*Asthmatic.* Subject to asthma.  
*Asthenia.* Weakness.  
*Astringent.* Contracting, counteracting looseness.  
*Atrophy.* A wasting of strength and flesh.  
*Auditory.* Relating to hearing.  
*Auricle.* 1. The outer ear; 2, a cavity of the heart.  
*Auscultation.* Listening to the sounds in the chest to detect symptoms of disease.  
*Autopsy.* Examination of a corpse.  
*Axillary.* Relating to the arm-pit.  
*Balsamic.* A medicine for healing.  
*Bifurcation.* Branching into two.  
*Bile.* The fluid secreted by the liver.  
*Bilious.* Having an excess of bile.  
*Bronchia.* A branch of the windpipe.  
*Bursa.* A sac.  
*Cachexia.* A bad condition of the system.  
*Cæcum.* The blind gut.  
*Calcareous.* Containing lime.  
*Calisthenics.* Light gymnastics.  
*Calculus.* A concretion in the excretory organs, as a stone in the bladder.  
*Callus.* The hard matter formed about the fractures of bones.  
*Canthrus.* The corner of the eye.  
*Capillary.* Hair-like; used especially of the small veins.  
*Capsule.* A gelatinous case for enclosing a dose of unpleasant medicine.  
*Cardiac.* Relating to the heart.  
*Carminative.* A medicine which expels the wind from the bowels.

*Carpus.* The wrist.  
*Cartilage.* Gristle.  
*Catalysis.* Paralysis.  
*Catamenia.* The monthly courses of women.  
*Cataplasm.* A poultice.  
*Catarrh.* Unnatural discharge from a mucous membrane.  
*Cathartic.* A medicine which opens the bowels freely.  
*Catheter.* A hollow tube for drawing off the urine.  
*Caustic.* A substance which burns living tissues.  
*Cauterize.* To apply caustic.  
*Cellular.* Composed of cells.  
*Cerebellum.* The lower part of the brain.  
*Cerebrum.* The upper part of the brain.  
*Cerumen.* A wax-like secretion, as the wax of the ear.  
*Cervical.* Pertaining to the neck.  
*Cervix.* A neck, or the neck.  
*Cesspool.* A privy.  
*Chalybeate.* Containing iron.  
*Chancre.* The sore of syphilis.  
*Cholagogue.* A medicine which increases the flow of bile.  
*Choleric.* Pertaining to bile.  
*Chronic Disease.* A protracted, slow disease.  
*Chyle.* The liquid formed from food by digestion.  
*Chyme.* The pulp formed from food by the gastric juice.  
*Cicatrix.* The scar from a wound.  
*Climacteric.* Puberty and change of life are the climacteric periods.  
*Clinical.* Pertaining to the bed.  
*Clonic.* Irregular, convulsive.  
*Clyster.* An enema, an injection.  
*Coagulate.* To change from a liquid to a denser state.  
*Coalesce.* To adhere.  
*Collapse.* Complete breaking down.  
*Colliquative.* Dissolving, applied to sweats and discharges which exhaust the system.  
*Collyrium.* A medicine applied to the eye.  
*Colon.* A portion of the large intestine.  
*Coma.* A condition of profound sleep.  
*Comatose.* In a state of coma.  
*Combustion.* Burning.  
*Concretion.* A hardened mass made up of gathered particles.  
*Condiment.* An article used to make food more savory.  
*Condyle.* A prominence of the joints.  
*Congenital.* Born with a person.  
*Congestion.* Accumulation of blood in a part.  
*Conjunctiva.* A mucous membrane of the eye.  
*Constipation.* Insufficient expulsion of the excrement.  
*Constriction.* A narrowing or contraction.  
*Contaction.* A disease caught by contact.  
*Contamination.* Pollution.  
*Contusion.* A bruise.  
*Convalescence.* Condition of recovery after a sickness.  
*Convuluted.* Rolled one part on another.  
*Cordial.* A strengthening, inspiriting medicine.  
*Coriaceous.* Leather-like, elastic and tough.

*Corrective.* A substance added to a medicine to modify its action.  
*Corroborant.* A tonic.  
*Corrosive.* A substance which disintegrates living tissue.  
*Cosmetics.* Substances used to beautify the complexion.  
*Costiveness.* Same as constipation.  
*Counter-irritant.* A medicine which relieves irritation in one organ by increasing it in another.  
*Cranium.* The skull.  
*Crassamentum.* The thick part of the blood.  
*Crepitas.* Abrupt, harsh sound.  
*Crisis.* The turning point of a disease.  
*Cutaneous.* Pertaining to the skin.  
*Cyst.* A sac or pouch.  
*Decoction.* A medicine made by boiling some substance in water.  
*Decomposition.* Decay.  
*Dejection.* A fecal discharge.  
*Delirium.* A wandering of the mind.  
*Demulcent.* A medicine which removes the pain of wounded or diseased parts.  
*Dentition.* Teething.  
*Deobstruent.* A medicine which removes obstructions from the passages of the body.  
*Deplete.* To empty.  
*Depuration.* Cleansing from impurities.  
*Desiccate.* To become dry.  
*Desquamation.* Scaling.  
*Detergent.* A medicine that cleanses wounds, etc.  
*Determination.* Strong direction toward some point.  
*Diagnosis.* The distinguishing of one disease from another.  
*Diaphragm.* The muscular partition between the thorax and the cavity of the abdomen.  
*Diathesis.* Natural disposition of the system.  
*Dilatation.* The act of dilating.  
*Diluent.* A liquid used to dilute and weaken a medicine.  
*Discutient.* A remedy for resolving or forcing back swellings.  
*Disinfectant.* A substance which destroys the germs of disease in the air.  
*Dislocation.* Throwing out of the natural position.  
*Distention.* A stretching, an expanding.  
*Distillation.* The process of converting a fluid to a vapor, and then reducing it again to its first form.  
*Diuresis.* Excretion of the urine.  
*Diuretic.* A medicine which promotes the flow of urine.  
*Domestic.* Belonging to the home.  
*Dorsal.* Pertaining to the back.  
*Drastic.* A medicine which acts powerfully.  
*Duodenum.* The first of the small intestines.  
*Dyspnoea.* Difficulty of breathing.  
*Dysuria.* Difficulty in evacuating the urine.  
*Ecstasy.* Excessive excitement; loss of mental control.  
*Edema.* See Œdema.  
*Effete.* Worn out, exhausted.  
*Effluvia.* Invisible exhalations from bodies.



- Efflux.* A flowing out.  
*Effusion.* The escape or the secretion of fluids.  
*Electuary.* A medicine whose ingredients are mixed with a syrup.  
*Eliminate.* To strike out, to throw out.  
*Emaciation.* The state of being thin and weak.  
*Emesis.* Vomiting.  
*Emetic.* A medicine which causes vomiting.  
*Emmenagogue.* A medicine which promotes the menstrual flow.  
*Emollient.* An external application to allay irritation.  
*Emphysema.* A swelling produced by air in the tissues.  
*Empirical.* Depending upon experiment, wanting in science.  
*Empyema.* A collection of blood, pus, etc.  
*Emulsion.* A milk mixture containing oil, water, and mucilage.  
*Endemic.* A disease peculiar to a people or nation.  
*Endermically.* Through the skin.  
*Enema.* An injection.  
*Engorgement.* Overfullness or obstruction of a vessel.  
*Enteric.* Belonging to the intestines.  
*Ephmera.* A fever of one day's continuance.  
*Epidemic.* Prevalent among the people.  
*Epidermis.* The outer skin.  
*Epigastrium.* The upper part of the abdomen.  
*Epiglottis.* The membrane covering the gullet.  
*Epispastic.* An external application to the skin.  
*Epistaxis.* Bleeding from the nose.  
*Epithelium.* The layer of cells which covers many of the membranes.  
*Erosion.* An eating or wearing away.  
*Eruetation.* The act of belching.  
*Eruption.* A disease of the skin.  
*Erysipelatous.* Pertaining to erysipelas.  
*Erythematic.* Causing a morbid redness of the skin.  
*Eschar.* A dry slough or scurf.  
*Etiology.* The branch of medicine which treats of the causes of disease.  
*Eustachian Tube.* The inner channel of the ear.  
*Evacuant.* A medicine which promotes evacuations of the bowels.  
*Evacuation.* Movement of the bowels.  
*Exacerbation.* A periodical increase of violence in a disease.  
*Excitant.* A medicine which arouses the vital activity of the body.  
*Excoriated.* Galled, abraded.  
*Excrement.* Matter ejected from the bowels.  
*Exerescence.* An unnatural appendage, as a wart or bunion.  
*Excretion.* Excrement.  
*Exfoliation.* The scaling off of a bone.  
*Exhalation.* That which is breathed out; that which rises as a vapor.  
*Expectorate.* To spit or cough out from the bronchial apparatus.  
*Expectorant.* A medicine which promotes discharges from the throat or lungs.  
*Expiration.* A breathing out.  
*Extravasation.* The act of forcing a fluid out of its proper vessels.
- Extremities.* Used to designate the hands and feet.  
*Exudation.* Sweating, a discharge of moisture.  
*Fæces.* Excrement.  
*Fæculent.* Pertaining to fæces.  
*Farinaceous.* Containing or composed of flour.  
*Fascia.* The thin covering of the muscles.  
*Fauces.* The back part of the mouth.  
*Faucet.* A fixture for drawing liquor from a vessel.  
*Febrifuge.* A remedy for fever.  
*Febrile.* Pertaining to fever.  
*Ferruginous.* Containing or made of iron.  
*Fetid.* Having an offensive pain.  
*Fetor.* An offensive smell.  
*Fibrine.* An elastic, whitish, tough substance found in organic matter.  
*Filtration.* The act of passing through a filter.  
*Fistula.* A deep, narrow, chronic abscess.  
*Flaccid.* Lax, soft, flabby.  
*Flashing-Point.* The temperature at which gas from an oil will ignite if brought in contact with a flame.  
*Flatulence.* The state of having wind on the stomach.  
*Flatus.* Wind generated in the stomach.  
*Flocculent.* Adhering in flakes.  
*Fœtus.* The young in the womb.  
*Flushing.* Cleansing by a sudden rush of water.  
*Flux.* Flow.  
*Follicle.* A gland, a cavity.  
*Fomentation.* A warm lotion applied to ease pain.  
*Foramen.* A little opening, a perforation.  
*Forceps.* A two-bladed instrument for grasping objects firmly.  
*Formication.* A creeping sensation.  
*Function.* Office, duty.  
*Fundament.* The anus.  
*Fungus.* A spongy, morbid growth.  
*Fungous.* Pertaining to a fungus.
- Gargle.* A liquid preparation for washing the throat.  
*Gastric.* Belonging to the stomach.  
*Gelatinous.* Like or containing gelatine.  
*Genitals.* The organs of generation.  
*Gestation.* Carrying the child in the womb.  
*Gland.* A cell or collection of cells which secrete some fluid from the blood.  
*Glandular.* Pertaining to glands.  
*Glottis.* The upper part of the windpipe.  
*Glutinous.* Resembling or containing glue.  
*Granular.* Consisting of or resembling grains.
- Hallucination.* A mental disorder in which one thinks he perceives objects which do not exist.  
*Hectic.* The fever of advanced disease.  
*Hemorrhage.* Discharge of blood from the blood-vessels.  
*Hepatic.* Pertaining to the liver.  
*Hereditary.* Handed down from one's parents.  
*Hernia.* Protrusion of the viscera.  
*Hydragogue.* A medicine causing watery evacuations.  
*Hydrothorax.* Dropsy in the chest.

*Hygiene.* That branch of medical science which treats of the preservation of health.

*Hymen.* The membrane which covers the mouth of the vagina.

*Hyperæsthesia.* A state of exalted sensibility of a part of the body.

*Hypertrophy.* An unusual bulk of some organ.

*Hypnotic.* Having the quality of producing sleep.

*Hypodermic.* Under the skin.

*Hypogastrium.* The lower part of the abdomen.

*Ichor.* A thin, watery humor.

*Idiopathic.* A peculiar individual affection.

*Idiosyncrasy.* A peculiarity of constitution.

*Illuminant.* That which affords light.

*Impotence.* Want of power.

*Impurity.* That which is impure, foul matter.

*Inanition.* Emptiness, exhaustion from want of food.

*Incontinence.* Want of self-restraint.

*Incubation.* The maturing of a contagious poison.

*Incubus.* The nightmare.

*Indigenous.* Native, produced naturally in a country.

*Induration.* The act of hardening.

*Infection.* The communication of disease.

*Inflammation.* Redness and swelling of a part.

*Inflate.* To distend, to swell up.

*Infusion.* Extraction of properties by steeping.

*Inguinal.* Pertaining to the groin.

*Inhalation.* The act of drawing into the lungs.

*Inhale.* To draw into the lungs.

*Injection.* Throwing a liquid into a cavity of the body by means of a syringe.

*Inoculation.* Communication of disease to a healthy person by inserting contagious matter under the skin.

*Insomnia.* Sleeplessness.

*Inspiration.* Breathing in.

*Inspissation.* The act of rendering a fluid substance thicker by evaporation.

*Integument.* A covering, as the skin.

*Intercostal.* Between the ribs.

*Intermittent.* Ceasing at intervals.

*Intra.* Within.

*Intussusception.* The slipping down of one part of a tube into another.

*Irrigate.* To wash out.

*Labia.* The lips.

*Lactation.* Milking.

*Lachrymal.* Pertaining to or secreting tears.

*Lacteals.* Absorbent vessels conveying chyle.

*Larva.* An insect in its earliest form after leaving the egg.

*Laryngoscope.* An instrument for viewing the larynx.

*Laryngotomy.* The operation of cutting the larynx.

*Larynx.* The upper part of the windpipe.

*Lateral.* Sidewise.

*Laxative.* A medicine which loosens the bowels.

*Lesion.* A hurt or injury.

*Lethargy.* Drowsiness, heaviness.

*Lienteric.* Pertaining to a special form of diarrhœa.

*Ligament.* The strong substance binding together the bones.

*Ligature.* A cord for tying blood-vessels.

*Linctus.* A soothing cough medicine.

*Liniment.* A soft ointment for bathing bruises, etc.

*Lithontriptic.* A medicine which destroys the stone in the bladder.

*Lithotomy.* The cutting operation for stone in the bladder.

*Lithotripsy.* The crushing operation for stone in the bladder.

*Lobe.* A round, projecting part of an organ.

*Lochia.* The evacuations from womb and vagina following childbirth.

*Lumbar.* Pertaining to the loins.

*Lymph.* A colorless fluid in animal bodies.

*Macerate.* To steep almost to solution.

*Malarial.* Pertaining to malaria.

*Malleolus.* A projection of the ankle-bone.

*Mamma.* The female breast.

*Mania.* Violent derangement of the mind.

*Matrix.* The womb.

*Maxilla.* The jaw-bone.

*Meatus.* A wide, natural passage.

*Meconium.* The first evacuations of an infant.

*Membrane.* A thin, extended, transparent tissue.

*Meninges.* The three membranes that envelope the brain.

*Menses.* The monthly flow of females.

*Menstrual.* Pertaining to the menses.

*Metastasis.* The sudden removal of disease from one part to another.

*Micturition.* The act of making water.

*Miasm.* Infection floating in the air.

*Midwife.* A woman who serves at a childbirth.

*Minim.* A drop.

*Minimum.* The least.

*Mitral Valves.* The valves of the heart.

*Morbid.* Not sound and healthful.

*Morbific.* Causing disease.

*Mortification.* Decay.

*Mucous Membrane.* The membrane lining all the cavities of the body which open externally.

*Mucus.* A viscid fluid secreted by the mucous membrane.

*Nævus.* A birthmark.

*Narcotic.* A medicine which relieves pain and produces sleep.

*Nausea.* Inclination to vomit.

*Nauseant.* A medicine which produces nausea.

*Necrosis.* Decay, especially of the bone.

*Nephritic.* Pertaining to the kidneys.

*Nervine.* A medicine which soothes nervous excitement.

*Node.* A knot or protuberance.

*Normal.* Healthy, natural.

*Nostalgia.* Homesickness.

*Nostrum.* A quack or patent medicine.

*Nutritive.* Nourishing.

*Obesity.* Stoutness.

- Obstetrics.* The science of midwifery.
- Occipital.* Pertaining to the back of the head.
- Edema.* A swelling filled with fluid.
- Esophagus.* The gullet.
- Olfactory.* An organ of smelling.
- Ophthalmoscope.* An instrument for examining the eye.
- Opiates.* Narcotic medicines containing opium.
- Optic.* Pertaining to the eye.
- Orthopnea.* A disease in which a person can breathe only when sitting up.
- Ossification.* Turning into bone.
- Otoscope.* An instrument for examining the ear.
- Ovary.* The organ of the female which forms the eggs.
- Ovariectomy.* The surgical operation for ovarian disease.
- Ovum.* An egg.
- Palatableness.* Degree of pleasantness to the taste.
- Palliative.* A medicine which mitigates pain.
- Palpitation.* Violent and irregular beating of the heart.
- Panacea.* A cure-all.
- Panada.* A soft, nourishing food.
- Pancreas.* A gland of the abdomen.
- Papillae.* The minute elevations on the surface of the skin.
- Paralysis.* The impairment of the function of an organ.
- Parasite.* An animal or plant which lives upon another.
- Parotid Glands.* The glands of the cheeks which secrete the saliva.
- Paroxysm.* A spasmodic convulsion.
- Patella.* The knee-pan.
- Pathognomonic.* Characteristic of a disease.
- Pathology.* The science of the knowledge of diseases.
- Paturient.* Bringing forth young.
- Pectoral.* Pertaining to the chest.
- Pediculus* (*plural, Pediculi*). A louse.
- Percussion.* Judging of the conditions of internal organs by tapping upon the surface of the body.
- Perflation.* The act of blowing through.
- Pericardium.* The membranous sac which encloses the heart.
- Perineum.* The space between the anus and genitals.
- Periodicity.* The state of having regular periods of change.
- Periosteum.* The fibrous membrane covering the bone.
- Peristaltic.* Contracting in successive circles.
- Peritoneum.* The thin membrane covering the whole internal surface of the abdomen.
- Permeate.* To pass through the pores of a substance.
- Permeable.* That may be permeated.
- Perspiration.* Sweat.
- Petechiae.* Purple spots on the skin.
- Pharynx.* The cavity at the base of the skull.
- Phlebotomy.* The letting of blood.
- Phlegmon.* Inflammation of the cellular tissues.
- Phthisical.* Pertaining to phthisis.
- Physiognomy.* The face or countenance.
- Physiology.* The science of the organs and their functions.
- Plethora.* The state of being over-full.
- Pleura.* The membrane which covers the lungs.
- Plexus.* Any network of vessels, nerves, or fibres.
- Polypus.* A tumor with a narrow base.
- Portable.* That may be carried.
- Post-mortem.* After death.
- Potable.* Drinkable.
- Pregnancy.* The condition of being with child.
- Premonitory.* Giving warning beforehand.
- Probe.* To examine a wound or sore by piercing it with a sharp instrument.
- Process.* Any protuberance or eminence.
- Prognosis.* The act of foretelling the course and end of a disease.
- Prolapsus.* The falling forward or downward of a part.
- Prophylactic.* A medicine which protects against disease.
- Pruritus.* Itching.
- Pseudo.* False.
- Ptyalism.* A morbid secretion of saliva.
- Puberty.* The age at which persons are capable of bearing or begetting children.
- Puerperal.* Pertaining to childbirth.
- Pulmonary.* Pertaining to the lungs.
- Pulmonic.* A medicine for diseases of the lungs.
- Pulse.* The beating of the heart and arteries.
- Pungent.* Bitter, acrid.
- Purgative.* A medicine which causes the bowels to be freely moved.
- Purulent.* Consisting of or resembling pus.
- Pus.* The yellowish white fluid produced by suppuration.
- Pustules.* A pimple on the skin containing pus.
- Putrid.* Decomposed, rotten.
- Pylorus.* The orifice of the stomach through which the food passes into the intestines.
- Rectum.* The lower end of the large intestine.
- Recurrent.* Returning from time to time.
- Refrigerant.* A medicine which allays fever or heat.
- Regimen.* Systematic treatment and diet.
- Regurgitate.* To throw back.
- Remission.* A temporary subsidence of disease or pain.
- Remittent.* Having remissions.
- Resolvent.* A medicine which has power to disperse inflammation.
- Respiration.* Breathing.
- Restorative.* A medicine which restores strength and vigor.
- Retina.* The internal nervous tissue of the eye.
- Revulsive.* Repugnant, hostile.
- Rheum.* A thin, serous fluid secreted by the mucous glands.
- Rigor.* A convulsive shuddering.
- Rubefacient.* An external application which produces redness of the skin.
- Saccharine.* Having the qualities of sugar.
- Saliva.* The secretion from the glands of the mouth.



- Salivation.* A continued unnatural flow of saliva.
- Salutary.* Wholesome, unnatural.
- Sanies.* A thin, serous fluid exhaled at the surface of ulcers.
- Sanguine.* Hopeful.
- Sanitary.* Pertaining to health.
- Sanitation.* The act of rendering healthy.
- Sciatic.* Pertaining to the hip.
- Scirrhus.* A particular kind of cancerous growth.
- Sclerotic.* The white outer coat of the eye.
- Scorbutic.* Pertaining to or affected with scurvy.
- Serofulous.* Pertaining to or affected by scrofula.
- Sebaceous.* Giving fatty secretions.
- Sedative.* A medicine which allays irritation.
- Sedentary.* Inactive.
- Semiflexion.* Bending half over.
- Senile.* Pertaining to old age.
- Septic.* A substance that promotes the putrefaction of bodies.
- Sequelæ.* The results of a disease.
- Serous.* Thin, watery.
- Serum.* The liquid portion of the blood.
- Sewerage.* The system of sewers.
- Sewage.* The refuse matters removed by sewers.
- Sialagogue.* A medicine which promotes the flow of saliva.
- Sinapism.* A poultice of powdered mustard seed.
- Sinew.* That which unites a muscle to a bone.
- Slough.* The dead part of a sore which separates and falls off.
- Solution.* A dilution.
- Solvent.* A medicine which dissolves callus or stony concretions.
- Soporific.* A medicine which induces sleep.
- Sordes.* Foul matter, excretions.
- Speculum.* An instrument for dilating and throwing light into certain passages of the body for the purpose of examining them.
- Sphincter.* A muscle that contracts an orifice.
- Spinal.* Pertaining to the spine.
- Sporadic.* Single, separate, scattered.
- Squamous.* Scaly, covered with scales.
- Stertorous.* Snoring.
- Stethoscope.* An instrument for listening to the sounds of the heart and lungs.
- Stimulant.* A medicine which quickly increases the vitality.
- Stomachic.* Pertaining to the stomach.
- Stool.* Act of expelling excrement.
- Strangury.* A painful discharge of urine.
- Strangulation.* Suffocation.
- Stricture.* The morbid contraction of a passage of the body.
- Strumous.* Pertaining to scrofula.
- Stupor.* Mental insensibility.
- Styptic.* An astringent medicine.
- Subcutaneous.* Under the skin.
- Submaxillary.* Under the jaw-bone.
- Sudorific.* A medicine which causes sweat.
- Suppurate.* To generate pus.
- Suture.* A seam, a sewing.
- Symptom.* A sign, a token.
- Syncope.* A faint or swoon.
- Synchronous.* Occurring at the same time.
- Syphilitic.* Pertaining to or infected with syphilis.
- Syphon.* A tube or pipe.
- Tartar.* The concretion which forms on the teeth.
- Tepid.* Lukewarm.
- Tetanic.* Pertaining to tetanus.
- Therapeutics.* That part of medicine which respects the discovery and application of remedies.
- Thorax.* The bones of the chest.
- Tincture.* Spirits containing medicinal substances in solution.
- Tonic.* A medicine increasing the strength of the system.
- Tonsils.* The glands in the sides of the throat.
- Torpid.* Dull, stupid, sluggish.
- Torpor.* Inactivity.
- Torsion.* The act of turning or twisting.
- Trachea.* The windpipe.
- Tracheotomy.* The surgical operation for croup.
- Transpiration.* Exhalation from the skin.
- Transude.* To pass through the pores.
- Trap.* The arrangement in a pipe to prevent escape of foul gas.
- Traumatic.* A medicine used to cure wounds.
- Tremor.* An involuntary shivering.
- Triturate.* To rub or grind to a powder.
- Tubercle.* A swelling or tumor.
- Tumefaction.* The act of swelling.
- Tympanum.* The drum of the ear.
- Typhoid.* Weak, low.
- Typhus.* An exhaustive fever.
- Ulcer.* A sore-secreting pus.
- Ulna.* The larger bone of the forearm.
- Urea.* An animal substance of the urine.
- Ureter.* The excretory duct of the kidney.
- Uric Acid.* The acid contained in the urine.
- Urine.* The secretion from the bladder.
- Urinary.* Pertaining to the urine.
- Uterus.* The womb.
- Uvula.* The soft part of the palate.
- Vaccine.* Derived from cows.
- Varicose.* Unusually enlarged.
- Vascular.* Pertaining to or full of vessels, such as veins and arteries.
- Venesection.* The operation of opening a vein, phlebotomy.
- Venous.* Pertaining to the veins.
- Ventilation.* The act of causing fresh air to pass through a place.
- Ventral.* Belonging to the belly.
- Ventricle.* A small cavity in a body.
- Vermifuge.* A medicine to remove worms.
- Vertebra.* A bone of the spinal column.
- Vertigo.* Dizziness or swimming of the head.
- Vesicant.* A blistering application.
- Vesication.* The process of raising blisters on the skin.
- Vesicle.* A membranous cavity.
- Veterinary.* Pertaining to the art of treating the diseases of domestic animals.
- Virile.* Of or pertaining to a man.
- Virus.* Contagious or poisonous matter.
- Viscera.* The contents of the abdomen, as the stomach, intestines, etc.
- Viscid.* Sticky, glutinous.
- Vitiate.* To spoil, to contaminate.
- Volatile.* Capable of wasting away.

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